POWER

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Steam or Vapor

A READER of *Power* has been asked to settle an argument as to "whether steam and vapor are one and the same thing, and if not, when is the line of demarcation drawn between them?"

The question is rather interesting when one comes to look it up.

Webster defines steam as "The invisible gas or vapor into which water is converted when heated to the boiling point; water in the state of vapor."

If one were inclined to be quarrelsome, one might object that water is not converted into steam when heated to the boiling point without the application of a large quantity of heat of evaporation, and that water can be in a state of vapor only in the sense that ice can be in a state of water. When the ice becomes water it ceases to be ice, and when the water is evaporated it ceases to be water.

But the meaning is obvious.

Steam is the vapor of water. It is H_2O in the vaporous or gaseous state.

All horses are animals, but all animals are not horses.

All steam is vapor, but all vapor is not steam.

Emmet runs turbines with mercury vapor. Refrigerating machines compress ammonia vapor. Nobody speaks of the steam of mercury or of ammonia.

"Steam" is reserved for the vapor of water.

Evaporation, the breaking up of the water into steam, occurs when the motion of its molecules is so rapid that their centrifugal force overcomes their mutual attraction and the effect of the external pressure in holding them together.

The temperature is a measure of the momentum, the *vis viva* of the molecules and so, indirectly, of their velocity.

If every particular molecule in a mass had this or a greater velocity, I imagine that the substance would have the properties of and follow the laws of a perfect gas.

But probably when the liquid is all apparently evaporated, there are some lagging molecules, and the nearer a vapor approaches its point of saturation or condensation the farther it departs from the ideal gaseous condition.

F. R. Low

Mad River Plant of the Ohio Edison Co.

By Paul A. Vickers

Engineer, Commonwealth Power Corporation of Michigan

NEAR Springfield, Ohio, the initial unit of an ultimate 80,000-kw. plant has been installed. The plant contains numerous modern features such as the cooling of the furnace walls by armored tubes, combination superheaters, economizers, air preheaters, three-stage bleeding, to heat the feed water, two-motor fan drive and ash sluicing. Feed water enters the boiler at 280 deg. F., and the combustion air is preheated to 310 deg. F. Working steam conditions are 450 lb. pressure and 245 deg. F. superheat when passing 120,000 lb. of steam per hour.

THE first 20,000-kw. turbine in the Mad River plant of the Ohio Edison Company, Springfield, Ohio, has been brought up to speed and it is planned to allow a month for making tests, perfecting operating routine and getting the plant into smooth operation before it is put into service. When this is completed, most of the load of the Rockway plant will be transferred to the new plant and the Rockway plant will be used to take the peak loads and afford reserve capacity.

A few years ago the question of purchasing power was considered seriously, but after a careful study of the advantages and disadvantages of such a program it was decided that equivalent reliability could be achieved more economically by building a plant for an ultimate capacity of 80,000-kw. at the junction of Mad River and Buck Creek, near Springfield, Ohio. The poor load factor under which it was expected that this plant would operate for the first few years was a strong argument in favor of purchasing power. On the other hand, in order to make a reliable source of low-priced power, it would have been necessary to build a transmission line, the cost and reliability of which would have had to be considered.

The first part of the work to be done was the construction of three-eighths of a mile of fill for a railroad siding and about 450 ft. of concrete trestle, two-thirds of which was for double track. This trestle consists of concrete piers 25 ft. high, spaced 23-ft. centers. The rails were laid on 26-in. girder beams and tied together with diagonal and cross bracing. A 4½-ft. sidewalk is provided on each side by cantilevering from the girder-beam stringers.

Beneath the trestle, near the east end of the present plant, is a concrete coal receiving hopper which discharges to a 30-in. reciprocating plate feeder supplying coal to a 60-ton crusher. Provision is made to bypass all coal up to a size of 1¼ in. From the crusher the coal passes to a 24-in. belt conveyor which carries it over an 18-in. magnetic pulley to a double-strand chain continuous-bucket type elevator with a speed of 100 ft. per minute.

A scraper conveyor takes the discharge from the elevator and delivers it through six openings in the scraper trough to two 150-ton bunkers. These bunkers can be filled completely in five hours, and have sufficient capacity to supply a 24-hour load. All coal-handling equipment is inclosed in dust-tight casings from the track-hopper outlet to the bunkers and is designed with ample doors for inspection and repairs.

The location of the track hopper and elevator makes it possible to serve the addition for the second unit of the plant with the installation of only a scraper conveyor for the next two bunkers. By a slight speeding up of the coal-handling equipment, double capacity of the plant can be served by operating it eight hours a day.

Coal storage and reclaiming will be done by a locomotive crane. A cable drag scraper, to be installed later, will make a storage area for 50,000 tons available.

The coal, after leaving the bunkers, passes through non-segregating chutes to the stokers serving the two boilers. Stoker firing was decided upon because of the operating conditions, since there was found to be little difference in first cost between this and pulverized fuel. The Rockway Plant is fired with underfeed stokers, and the operation has been so satisfactory that, from the outset, stokers have been in favor. There is also the advantage of having the same type of equipment in both plants. It was kept in mind, however, that it might be desirable to change to pulverized fuel for later installations; consequently, the design of the building is such that it may be adapted easily to either type of firing. The present stokers are of the underfeed type, 14 retorts wide and 20 tuyeres long, driven by variable-speed motors.

Boiler Features

Two boilers have been included in the initial installation. It was felt that the size and nature of the present load, together with the reliable reserve capacity at Rockway Station, made it possible to save carrying charges on the new plant and still provide good service. The boilers are of the sectional-header cross-drum type, built for a working pressure of 450 lb. gage. Each boiler is

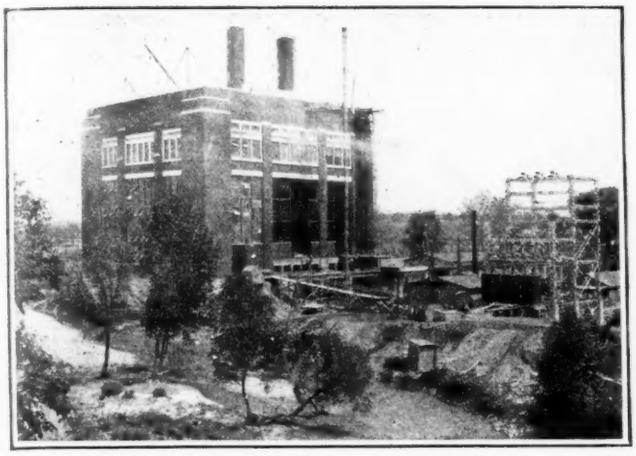


Fig. 1—The new Mad River plant of the Ohio Edison Company near Springfield, Ohio, presents a pleasing appearance

42 tubes wide and 12 tubes high. A slag screen is provided by the omission of one row of tubes below the horizontal baffle. The total heating surface in the boiler and water walls is 13,415 sq.ft., of which the water walls have 655 sq.ft. Combination superheaters consisting of a convection superheater between the first and second pass of the boiler and in series with a radiant element in each side wall, give a superheat of 245 deg. F. when passing 120,000 lb. of steam per hour. An automatic feed-water regulator at each boiler is supplemented by a differential-pressure regulator.

Ash and clinkers pass between two 18-in. crusher rolls and fall on refractory-lined inclined plates from which they are washed into the ash sluice by twelve jets under each boiler, operating at 75 lb. pressure. Two larger nozzles at the end of the trough and two between the boilers, sluice the ash into a concrete basin from which it is pumped to low ground east of the plant.

Walls of Furnaces Water Cooled

The rear and side walls of the furnaces are water-cooled by armored tubes. On the rear wall the tubes occupy the whole width of the furnace and extend downward nearly to the bottom of the ashpit. Those of the side walls divide the area with the radiant elements of the combination superheater.

Waste heat in the flue gases is absorbed by both economizers and air preheaters. With this combination it is expected to provide boiler-feed water at 280 deg. F.; air at 310 deg. F. and flue gases passing to the stack at 310 deg. F. under average full-load conditions. The economizers are of the steel-tube type with cast-iron rings, having a heating surface of 4,608 sq.ft. and designed for a pressure of 500 lb. Plate-type air preheaters with a rated surface of 14,220 sq.ft. have $\frac{3}{4}$-in. air by 1-in. gas spacing. Although the preheaters will not require cleaning often, provision is made for flushing them down from the top when the boiler is out of service. Regular cleaning of the economizers and the boiler tubes will be done with permanently installed soot blowers.

Regulation of the draft is by automatic control acting upon the dampers of the forced-draft fans. Each fan has a variable-speed motor on either end of the shaft, and they are interlocked so that when one is driving the fan, the other is idling. Two self-supporting steel stacks, 10 ft. in diameter and 40 ft. high above the building parapet, serve the two boilers.

The heat balance of the station was computed upon the basis of bleeding the turbine at three points. The fourth-stage bleeder supplies the evaporator, and the eighth- and eleventh-stage bleeders each supplies a closed feed-water heater. Vapor from the evaporator enters the steam line supplying the eighth-stage heater. Drips from the eleventh-stage heater will be fed into the boiler feed line just ahead of the eighth heater, but it can be discharged into the hotwell at a slight penalty in heat economy.

During the construction of the fill for the railroad siding, the borrow pit filled up with ground water and has remained so since that time. It was found that this water was of a better quality than that obtained from the river, so it will be used as the raw-water supply to the evaporator. The average makeup is estimated at about 2 per cent, but the evaporator is capable of handling a maximum makeup of about 5 per cent of the total boiler feed at full load.

There are three 500-g.p.m. boiler-feed pumps operating between common headers on the suction and discharge sides. Two of these are motor-driven and are used for regular service, while the third is turbine-driven and is used for stand-by service.

Vacuum Cleaning System

The plant has a vacuum cleaning system serving the entire building. Two receiving tanks in series extract most of the dirt from the lines and discharge it to the bunkers. To avoid sharp bends or projections, drainage fittings were used throughout, with cleanout pockets installed at intervals. The capacity of the system is sufficient to provide a suction of 9 in. of mercury at the farthest nozzle.

The whole high-pressure steam piping system ties to the main steam manifold, a cast-steel swedged seamless header anchored to building steel. It is designed for 400-lb. and has 400-lb. A.E.S.C. flanges with large male and female faces. The main high-pressure steam valves have chrome nickel steel bodies. The boiler-feed lines are designed for 600-lb. service and also have A.E.S.C. flanges. Special bronze feed valves are used on the discharge of the boiler-feed pumps. For the circulating intake and discharge lines the pipe has been built up

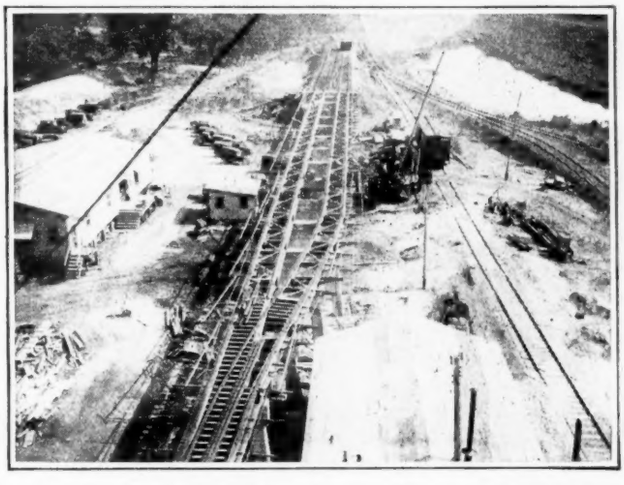


Fig. 2—Coal trestle showing cantilever supports for walkways on either side

of welded steel plate, replacing the customary cast-iron pipe and fittings. To eliminate vibration, expansion joints were installed in the circulating and condensate lines at the condenser.

The machine stands longitudinally in the turbine room on a floor extending the entire length of the room and about two-thirds of its width from the inside wall. A broad stairway leads down 8 ft. from this floor to an outside entrance in the center of the north wall. A view can be had of the entire turbine room, condenser and other auxiliaries on the floor below from the entrance platform. The turbine is a 14-stage machine rated at 20,000 kw. at 80 per cent power factor, and is arranged for bleeding from the fourth, eighth and eleventh stages. It is served by a surface condenser of the two-pass, divided water-box type. The circulating and condensate pumps are in duplicate, and a twin two-stage ejector with inter- and after-condenser removes the air. The circulating-water intake and screenhouse are in the west end of the main building. Parallel intake and discharge ducts of a capacity sufficient to service the present and all future units are in the base slab directly under the condenser and extend the length of the building. A 16-in. re-circulating line is carried from the condenser discharge to the intake in front of the racks to prevent needle ice.

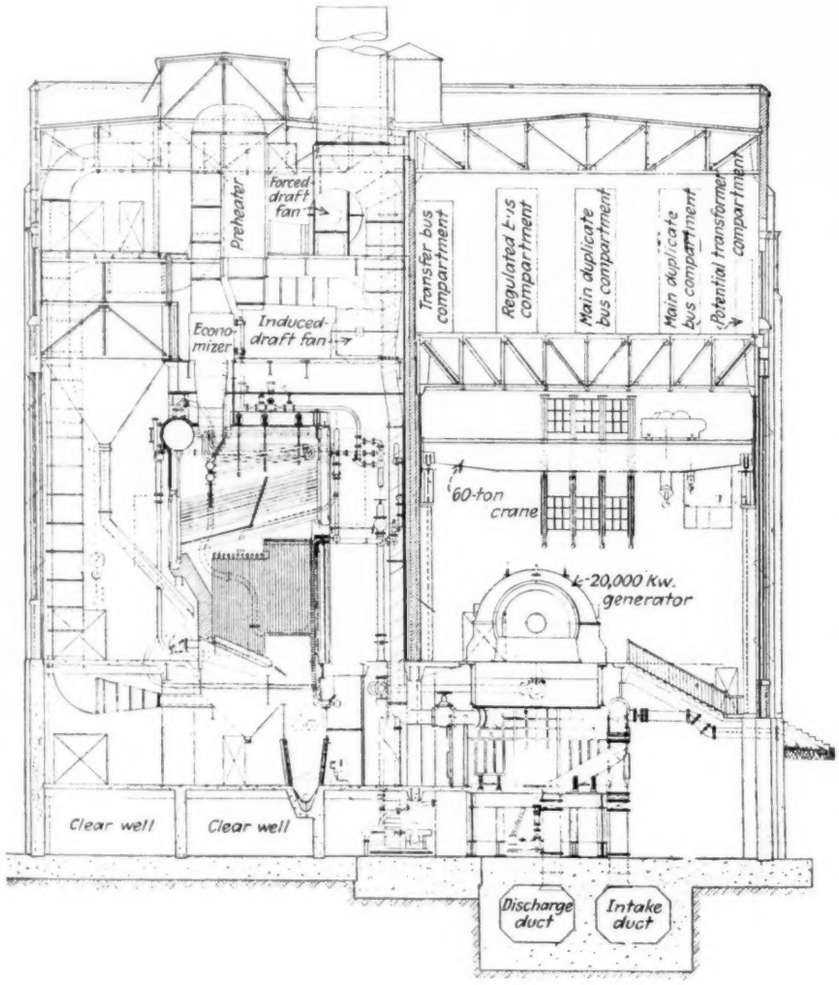


Fig. 3—Section through the new Mad River station showing the neat, compact and uniform arrangement of the equipment

When the boilers were filled for the first time, the water was pure condensate derived from two unit heaters installed during construction and used to heat and dry out the building.

The final plan of the plant includes a main and a duplicate 12,500-volt bus, a main and transfer 12,500-volt regulated bus together with the necessary switching equipment. These will be housed in concrete bus structures on a floor over the turbine room. At the west end of this floor will be four 1,080-kva. induction voltage regulators serving the four sections of the main regulated bus. In addition there will be concrete compartments containing the reactors, potheads and instrument transformers. The present installation provides for only the main bus structure and one regulator, together with a part of the concrete cell structures. The trusses over the turbine room, which support the main bus room floor, have been inclosed, and the height of 8 ft. thus made available is used for a cable gallery.

The switchboard room is at the permanent end of the building overlooking the entire turbine room. The generator panels are directly in front of the operator's desk, with the panels of the transmission switchboard and the regulated distribution switchboard arranged in circular arcs to the left and right for ready observation.

The generator is rated at 20,000 kw. 12,500 volts three-phase 60 cycles 0.8 p.f. The main and pilot exciters are mounted on the same shaft. A closed air system supplies clean air for the cooling of the generator.

Three single-phase transformers supply the 480-volt station power bus to which eleven circuits are connected. All station auxiliary motors are squirrel-cage induction machines with the exception of the turbine room and regulator room crane motors, which are of the slip-ring type. The two boiler-feed pump motors and the two circulating-water pump motors are on individual circuits. The remaining seven circuits take care of various groups such as turbine, boiler, screenhouse auxiliaries, coal and ash handling and miscellaneous equipment. With but few exceptions, starting is accomplished by throwing the motors directly across the line.

The plant is characterized by a compact layout and an arrangement of equipment that should contribute to the convenience of the operators. This should facilitate the complete realization of the economies for which the plant is designed.

The design and construction of the plant was carried on under the supervision of William W. Tefft, chief engineer of the Commonwealth Power Corporation of Jackson, Michigan, which controls the Ohio Edison Company, among other subsidiaries.

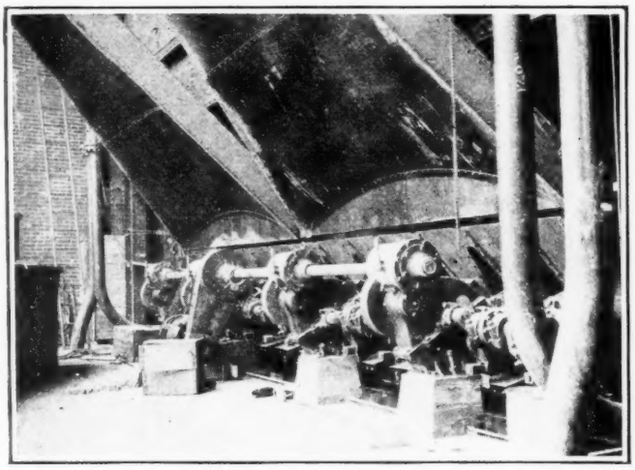


Fig. 4—Underfeed stokers and lower end of non-segregating coal chutes

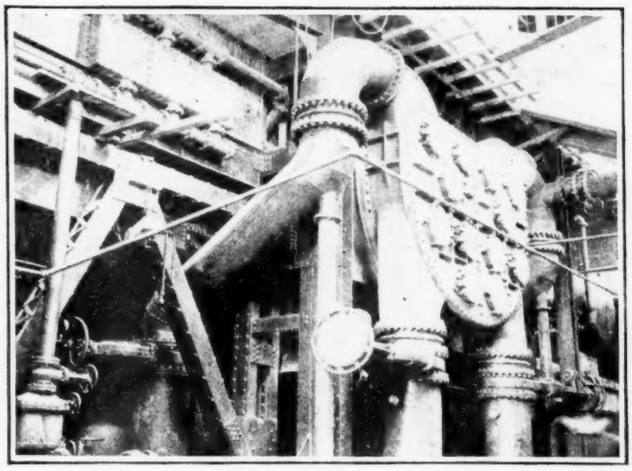


Fig. 5—End view of a condenser, with built-up intake and discharge pipes

PRINCIPAL MECHANICAL EQUIPMENT OF MAD RIVER PLANT, THE OHIO EDISON COMPANY

BOILERS AND AUXILIARIES

Boilers, cross-drum, two	Babcock & Wilcox Co.
Surface, sq.ft.	12,757
Pressure, lb. gage	450
Av. temp. feed water to boiler, deg. F.	280
Water-cooled walls, Foster armored type	Power Specialty Co.*
Surface, sq.ft.	658
Superheater, Foster, combination convection and radiant	Power Specialty Co.
Economizer, Foster steel tube, 4,608 sq.ft.	Power Specialty Co.
Soot blowers	Diamond Power Specialty Co.
Crushers, one, 60 tons per hour	Jeffrey Mfg. Co.
Stokers, Taylor, 14 retorts, 29 tuyeres	American Engineering Co.
Projected grate area, sq.ft.	352.7
Drive, motor, var. sp. with Louis Allis control, hp	10
Fans, forced-draft, two	American Blower Co.
Capacity, cu.ft. per min. at 9.8 in. static press.	70,000
Drive, two motors, hp	75 and 150 on each fan
Fans, induced-draft, two	American Blower Co.
Capacity, cu.ft. per min. at 8 in. static press.	120,000
Drive, two motor, hp	100 and 250 on each fan
Air preheaters, two, ¾-in. air by 1-in. gas spacing, plate type	Combustion Eng. Corp.
Surface, sq.ft.	14,220
Av. temp. inlet air, deg. F.	80
Av. temp. outlet air, deg. F.	310

FEED-WATER HEATERS AND EVAPORATOR

Heaters, closed, two	Griscom-Russell Co.
Capacity, 11th stage, 83 to 159 deg. F., lb. per hr.	220,000
Capacity, 8th stage, 159 to 224 deg. F., lb. per hr.	220,000
Evaporator, one, Reilly coil type	Griscom-Russell Co.
Capacity, lb. per hr. max.	11,000
Hot water storage heater	Griscom-Russell Co.

PUMPS

Boiler feed, centrifugal, three	A. S. Cameron Steam Pump Works
Capacity, gal. per min.	500
Drive of two pumps, motor, hp.	300
Drive of one pump, turbine, hp.	250
Service pumps, centrifugal, two	Union Steam Pump Co.
Capacity, gal. per min.	800 and 400
Drive, motor, hp	50 and 25
Air compressor, 10 x 9-in.	Ingersoll-Rand Co.
Capacity in cu.ft. free air per min.	245

COAL AND ASH HANDLING

One reciprocating plate feeder, 24-in. belt conveyor, bucket elevator and scraper conveyor	Jeffrey Mfg. Co.
Magnetic separator, Dings	Dings Magnetic Separator Co.
Storage coal crane, locomotive, 20 ton	Brown Hoisting Machinery Co.
Ash sluicing system	Allen-Sherman-Hoff Co.
Ash pumps, two	Morris Machine Works
Capacity, gal. per min. of water and lb. per min. of ashes	1,000 and 534
Drive, motor, hp	40

GENERATING UNIT

Manufacturer	General Electric Co.
Turbine, 14-stage, r.p.m.	1,800
Pressure at turbine throttle, lb. gage	375
Steam temperature, deg. F.	692
Steam bled from three points, approx. av. per cent	15
Generator, 3-ph., 60-cycle, 12,500 v.; kw. at 80 per cent p.f.	20,000
Exciter, direct-connected, 135 kw., 250 v.; pilot exciter 2 kw., 125 v.	
Generator air cooler, 6 pass, sq.ft. cooling surface	3,900

SURFACE CONDENSER

Two pass, divided water box	Elliott Co.
Tube surface, sq.ft.	27,000
Tubes	Muntz metal, 1 in. O.D.
Circulating pumps, centrifugal, two	Allis-Chalmers Mfg. Co.
Capacity, gal. per min.	17,500
Drive, motor, hp	150
Condensate pumps, centrifugal, two	Elliott Co.
Capacity, gal. per min.	600
Drive, motor, hp	50
Air pumps, twin steam jet with surface inter- and after-condenser	Elliott Co.
Capacity each unit at 28 in. vacuum, with 100-deg. intercondenser water, lb. per hr.	145

MISCELLANEOUS EQUIPMENT

Boiler-setting masonry	McCabe Construction Co.
Building	A. G. Samuelson
Car pullers	Mead-Morrison Co.
Combustion control	Carrick Eng. Co.
Elevators	Hollister-Whitney Co.
Equipment unloading and erection	R. E. Townsend
Excavation, foundations and railroad siding	O. W. Jenkins Co.
Heating and ventilating	The Victor Plumbing Co.
High-temperature insulating material	The Carey Co.
Low-temperature insulating material	S. P. Conkling
Instruments	The Foxboro Co., Inc.; Bailey Meter Co.
Piping	Pittsburgh Piping & Equip. Co.
Piping erection	H. E. Ysberg
Purifiers—Oil	The Sharples Specialty Co.
Steam	Andrews-Bradshaw Co.
Steel-plate work (ducts and breechings)	Littleford Bros.
Structural steel—Bldg., etc.	The Bellefontaine Bridge & Steel Co.
Turbine foundation	Milwaukee Bridge Co.
Traveling water screen	Chain Belt Co.
Turbine auxiliary	The Terry Steam Turbine Co.
Vacuum cleaning system	Allen & Billmyre Co.
Coal chutes, nonsegregating	Rolland Gardner & Co.

VALVES

Gate and globe	Chapman Valve Mfg. Co. Crane Co.
Turbine bleeder check	Schutte & Koerting Co.
Atmospheric relief	Atwood & Morrill
Boiler—stop check	Elliott Co.
Boiler—feed check	Smolensky Valve Co., Inc.
Blowoff	Manning, Maxwell & Moore, Inc. Everlasting Valve Co.
Safety, consolidated	Manning, Maxwell & Moore, Inc.
Boiler-feed regulators	(Copes) Northern Equip. Co. S-C Regulator Mfg. Co.
Excess-pressure regulators	D. H. Skeen & Co. (Mercoid) S-C Regulator Mfg. Co.

* The Power Specialty Co. is now a part of the Foster-Wheeler Corporation consolidation.

Rules for Applying Oil Circuit Breakers

By H. G. MacDonald

Circuit-Breaker Engineer, Westinghouse Electric & Manufacturing Company

Factors that should be considered when selecting oil circuit breakers and the features that these devices should possess to meet operating conditions successfully

MODERN lines of oil circuit breakers include a great variety of equipment, ranging in size from a small device containing about one gallon of oil to a huge structure requiring 15,000 gal. Roughly, they group themselves under three general classes: Industrial breakers, power-house breakers and those that are installed out of doors.

Industrial breakers are those used for the control and protection of small and moderate-sized motors for industrial applications. These breakers are usually small, compact, self-contained devices having frames or cases that entirely enclose all the working and current-carrying parts, oil tanks that fit tightly against the frames and in which the current interrupting members are immersed, as in Fig. 1. An operating handle extends to the outside of the case and the leads to and from the breaker pass through suitable insulating bushings.

Sometimes multiple- or single-conductor lead-covered cable forms the leads and wiped joints are made to bushings passing through the case of the breaker. The mechanism is usually the simplest possible lever system consistent with obtaining proper automatic release functions. The overload feature may be provided by series coils directly in the conducting circuit through the breaker. Overvoltage and undervoltage release devices are usually provided on this class of breaker in addition to the overload feature.

The contacts are of simple and substantial construction, as this class of breaker usually receives the least maintenance of any type. Finger-type contacts, Fig. 2, or perhaps butt-type contacts are used as affording maximum service with minimum maintenance. Breakers in this class are often entirely dust- and weather-proof for use in places where explosive dust may be present in the air or where excessive moisture is present. Such devices may even be had for operation where they may be entirely submerged under water, such as the type, Fig. 3. Mill-motor breakers, oil-well breakers, subway breakers, etc., all come under this classification.

In the power-house class come the large majority of oil circuit breakers which are used in connection with the generation of power, the protection of the generating apparatus and the transforming apparatus and the switching of the power until it passes into the step-up transformers prior to delivery into the transmission system. These breakers fall into two general groups—switchboard-mounted types and cell-mounted types — this grouping being in line with the volt-ampere requirements. Low voltages, 2,200 or less, and moderate currents, 1,200 amperes or less, may with reasonable safety to both oper-

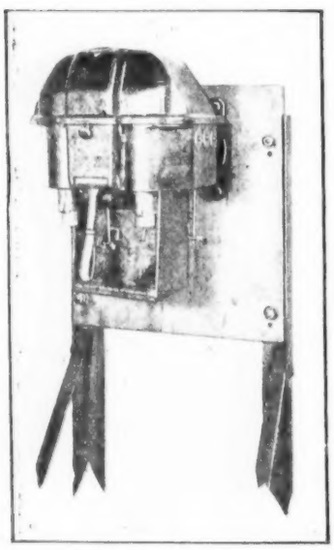


Fig. 1 — Industrial-type oil circuit breaker

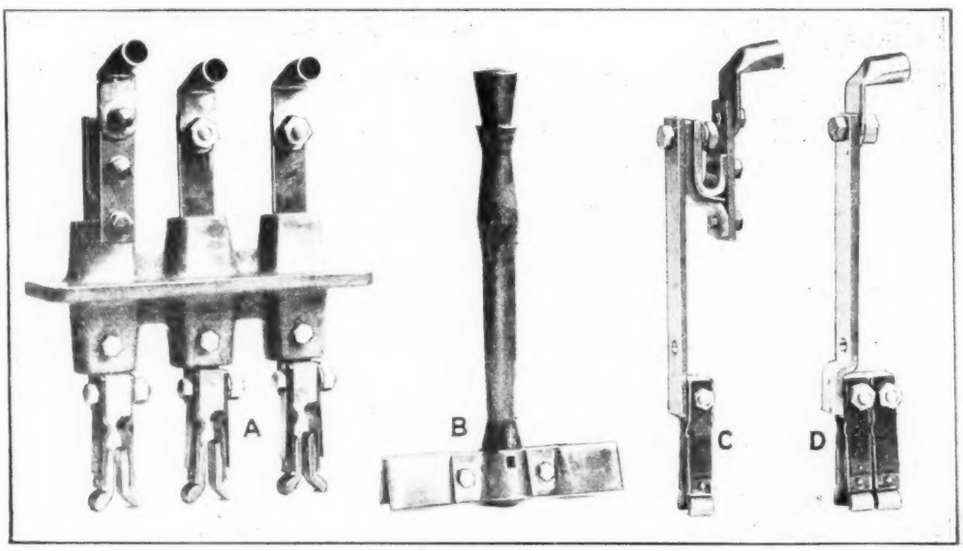


Fig. 2—Finger-type contacts used on industrial-type oil circuit breakers. A, C and D, finger-type contacts; B, one of the circuit closing members

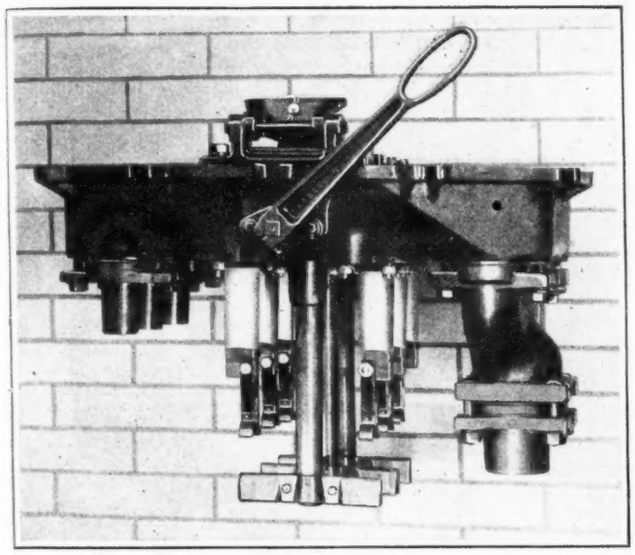


Fig. 3—Oil circuit breaker for use in wet places

ator and apparatus be brought to the rear of switchboard panels. The same general type, but of higher voltage rating and heavier current capacities, are made in remote-control form, in which the breaker units are placed at a distance from the switchboard and the operating means placed on the panel. Roughly, this type embodies a supporting frame or plate in which are mounted the insulators supporting the stationary contact members and the operating levers. The oil tanks are supported from the under side of the frame. The supporting frame is suitable for mounting on a panel or on a framework carrying the busbars.

Cell-Mounted Breakers

The cell-mounted breakers comprise the heavier-capacity moderate-voltage indoor breakers and are usually of the unit pole construction, each pole being located in a separate cell of masonry or steel, as in Fig. 4. The majority of cell-mounted breakers are electrically controlled for both ease and safety of operation.

In the outdoor class fall practically all high-tension breakers used in system distribution of power. The present tendency is to place outdoors all apparatus of 15,000-volt and above, and complete lines of circuit breakers are available for all voltages and capacities up to and including 220 kv. These breakers are usually of the unit-pole construction having a top casing which forms a support for the mechanism, insulating bushings and contacts and to which the oil tank is secured. The casing is thoroughly weatherproof and of a shape to be least liable to collection of snow, rain and ice.

On smaller breakers the units are mounted on a supporting framework, while the larger breakers are floor mounted, the tanks forming the base of the breaker. The bushings leading into the breakers are protected by suitable weather casings, and all operating means are protected by housings.

When a circuit breaker opens under load, an arc is formed between the stationary and moving contacts. The size of arc depends upon the voltage, the amount of current and the rate of separation of the contacts. The heat of the arc disintegrates some of the contact material and some of the oil in contact with the arc. The disintegrated oil forms a gas bubble of a size dependent on the amount of current in the arc and its duration. If the gas bubble is carried immediately away from the contacts and the contacts have been sufficiently separated, the arc will persist only until the next zero of the current wave.

The facility with which the gas bubble leaves the contacts depends upon the relative specific gravity of the gas and oil, the head, volume and viscosity of the oil and the disposition of the contact details. Liberal clearance around the contacts, allowing unimpeded oil movements, permits the pressure of the head of oil to force the gas bubble quickly out into the free oil space and upward into the expansion chamber.

Principles of Construction

There are certain fundamental principles of construction which are generally recognized as representing advanced practice: (1) Open position maintained by gravity so that the contacts fall open upon any injury to the mechanism. (2) Rapid acceleration of the contacts in opening, minimizing the duration of arc, tank pressure and deterioration of contacts. (3) Immersion of all live parts under a deep head of oil to prevent excessive development of gases. (4) Proper venting and baffling arrangement to provide regulated escape for gases formed during the interruption of heavy current. (5) Sturdy mechanical construction throughout. (6) Isolation of individual poles in insulated cells in moderate-voltage service and in separate tanks on high voltages, as in Fig. 4. (7) Generously proportioned, high pressure, wiping and self-cleaning contacts. (8) Protection of main contacts by arcing contacts, so located as to take advantage of the magnetic blowout to force the arc away from contacts, as in Fig. 5. (9) Electric solenoid magnet for electric operation. (10) Full automatic design of mechanisms, eliminating possibility of holding contacts closed against overload or short-circuit on the line.

In applying oil circuit breakers three main requirements must be considered; namely, current rating, volt-

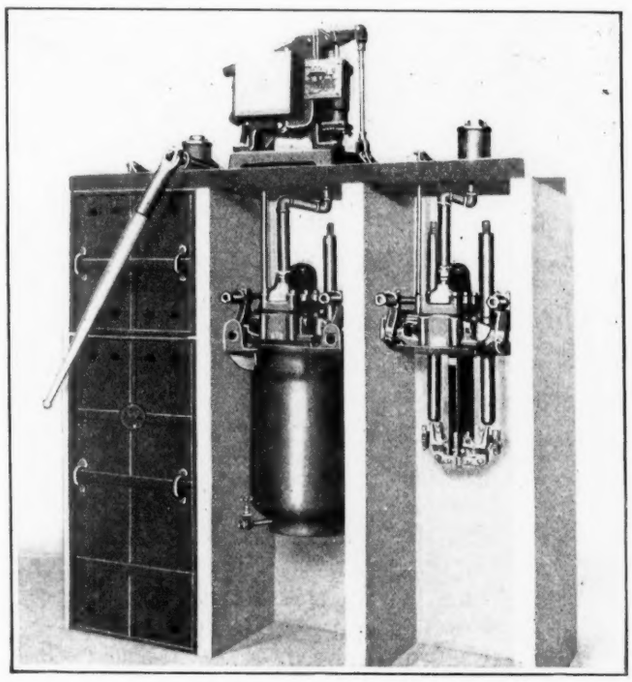


Fig. 4—Cell-mounted type of oil circuit breaker

age rating and interrupting ability. Items that should be considered when applying oil circuit breakers are given in Fig. 6.

The entire conducting circuit through the circuit breaker must be ample to carry the maximum continuous current to which the device will be subjected when in service. The contacts on light-current breakers may be of the finger or of the butt type, Fig. 2. In heavy-current breakers brush contacts are ordinarily used, Fig. 5. In properly designed breakers the brush will be designed so as to overcome or neutralize the magnetic forces tending to decrease the contact pressures during short-circuit. The entire contact and conducting circuit must have mechanical strength and thermal capacity to withstand the effects of the high values of short-circuit current occurring during the first few cycles of the duration of the short-circuit prior to the operation of the breaker.

Insulation Requirements

On the live parts of the breaker the insulation must be sufficient to withstand continuously the voltage impressed on these parts and with sufficient reserve to withstand the voltage surges that may occur due to various system conditions. The insulation must be permanent, not deteriorating with service, and the material used must have good mechanical qualities to withstand the shocks and strains incident to breaker operation. The insulation of the leads into and away from the breaker presents one of the major problems of design. The condenser brushing is one of the best solutions of this problem, as it presents the ideal condition of uniformly distributed voltage stress throughout the bushing and possesses great mechanical strength. For breakers of more moderate requirements of voltage and mechanical stresses porcelain insulators of proper design afford excellent insulation.

A breaker must be capable of interrupting the maximum short-circuit to which its location in the system may cause it to be subjected. A breaker may have ample conducting parts to carry the maximum continuous current to which it can be subjected and may be insulated to withstand the maximum impressed voltage and still may be incapable of opening the short-circuit which may occur on the circuit in which it is located. The breaker must

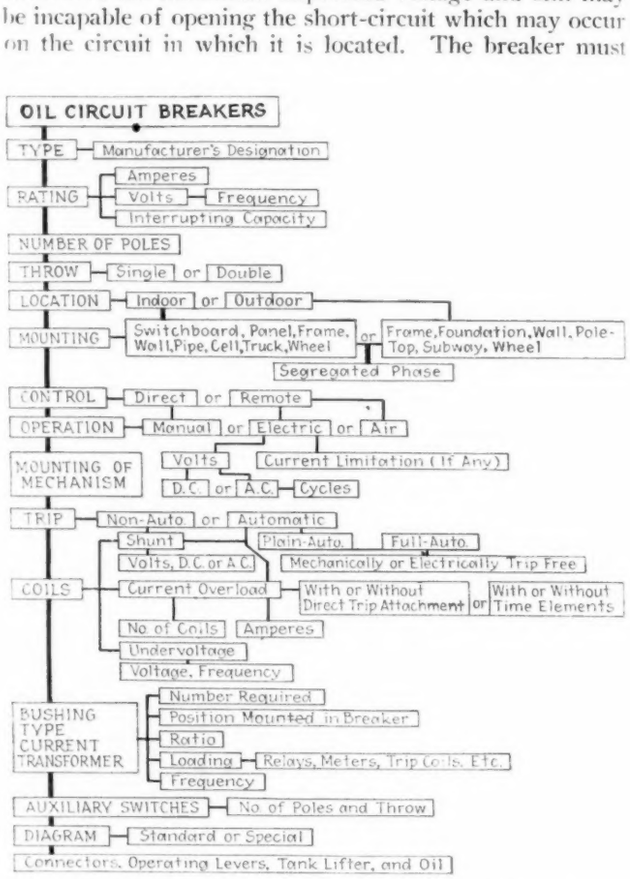


Fig. 6—Chart to be used when specifying oil circuit breakers

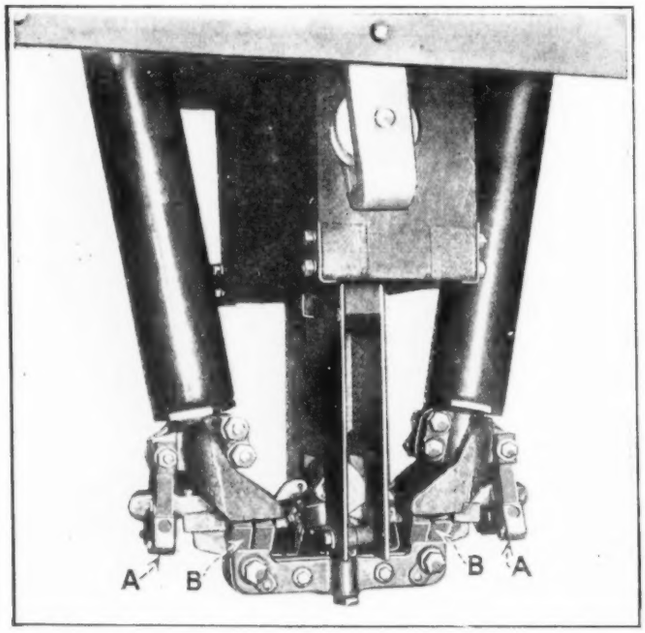


Fig. 5—Brush-type contacts used on large-capacity oil circuit breakers

A, auxiliary contacts on which the circuit is made and broken; *B*, main current-carrying contacts of the brush type

be constructed in all parts to withstand the conditions imposed during the opening of the short-circuit.

It has already been mentioned that when an arc is formed under oil, some of the oil and contact material are disintegrated. The insulating value of the oil is lowered by the products of the disintegration of both oil and contacts. The formation of gases, which are at high temperature, exerts pressure within the breaker structure. If the structure is not sufficiently strong and adequate means provided for the relief of the pressure, it will be ruptured. If too free relief of pressure is allowed, the gas in the arc space expands, forcing the oil away and exposing the contacts. An insulation failure may occur through the gas bubble, or the heated gas may communicate with the air in the expansion space above the oil and a violent explosion result.

Preventing Gas Explosions

The breaker structure must be sufficiently strong, the head of the oil above the contacts great enough and the pressure relief means so proportioned that adequate pressure be retained to force cool, clean oil into the arc area. This is necessary to keep the contacts submerged and surrounded with oil and assure that the escaping gas bubbles are cooled below the ignition point when they come in contact with the air. As this latter action may not always be accomplished and as the hazard exists of an ignition of explosive gas in the expansion space, it is

best practice to make the structure adequate to withstand such an explosion.

If the expansion space is kept of moderate size, the severity of the explosion may be diminished. The deterioration of the insulating value of oil and of other insulation within the breaker makes it necessary to use large factors of safety in all insulation details. As heavy magnetic stresses are set up in the conducting members upon the passage of large current, these details and the parts of the lever system which hold the contacts must all be made of liberatl dimensions. Modern operating practice requires that it must be possible to close a breaker against an existing short-circuit and immediately open the circuit. This makes it necessary to provide closing means adequate to close the contacts against the added opposing force exerted by the magnetic field set up by the heavy current.

Capacity of Conducting Circuits

All parts of the conducting circuit must have thermal capacity to carry safely the enormous current which may flow during the first few cycles of a short-circuit without melting or welding the contacts such as would prevent opening when the breaker mechanism operates. In explanation of the last statement it should be noted that in the ordinary construction of oil circuit breakers it is impracticable to make the breaker begin to part its contacts in less than about two tenths of a second from the time of the appearance of short-circuit current. This is due to the time required to build up magnetism in the trip coil, to release the holding latch of the breaker and to accelerate the moving portion of the breaker mechanism.

In the circuit, the maximum short-circuit current occurs during the first cycle subsequent to the appearance of the short. It gradually decreases from this value, assuming the alternator field exciting circuit to remain unchanged by automatic generator voltage regulators, until it reaches a steady value at the end of possibly one-half second. It is obvious therefore that the entire structure must be capable of withstanding stresses much in excess of those existing at the instant the breaker begins to interrupt the circuit. When it is also considered that the opening of the circuit breaker is often purposely delayed by time-limit relays, the necessity of ample thermal capacity is evident.

Oil Circuit-Breaker Rating

In the rating of breakers, in addition to current, voltage and interrupting capacity there is also given a five-second rating, this being the maximum current-carrying capacity for five seconds. In terms of full-load current rating the five-second rating is usually about 50 times. The several features entering into the ratings of breakers must all be given due weight in the design of the apparatus. A breaker is primarily a protective device and is expected to function as such when trouble occurs on any portion of the circuit in which it may be placed. Obviously, therefore, liberal factors of safety should be allowed on all parts entering into the device. Mechanisms and contacts should be as simple as is consistent with the duty to be performed. Ease of installation and of maintenance are factors that should recommend these devices. After these equipments are installed, they must be given periodic attention to insure their satisfactory operation, and the earlier these inspections can be made the more likely the parts will be given the necessary care.

What Do You Know?

The answers are on page 436

NO MATTER how technical an engineer may be in his training, he must know something of the practical side of engineering to succeed. Here are some questions, all of which refer to the practical, or operating, side of engineering. A choice is offered to readers to check their practical information. Compare your answers with those given and you should make a grade of 90 per cent.

Ques. 1—Why is an eccentric used in preference to a crank for valve mechanisms?

Ques. 2—When should a boiler be blown down; when banked or during heavy steaming?

Ques. 3—What advantages are gained by using superheated steam in reciprocating engines?

Ques. 4—What is meant by a 20-ton refrigerating machine?

Ques. 5—Why do pumps have a number of small valves rather than a few larger ones?

Ques. 6—What is the difference between a Trick valve and an ordinary D slide valve?

Ques. 7—What is the rule of the length of splices for leather belts?

Ques. 8—Why is a monkey wrench usually provided with left-hand adjusting screws?

Ques. 9—Is it possible through the heat given up by the condensation of one pound of steam to evaporate two pounds of water into steam?

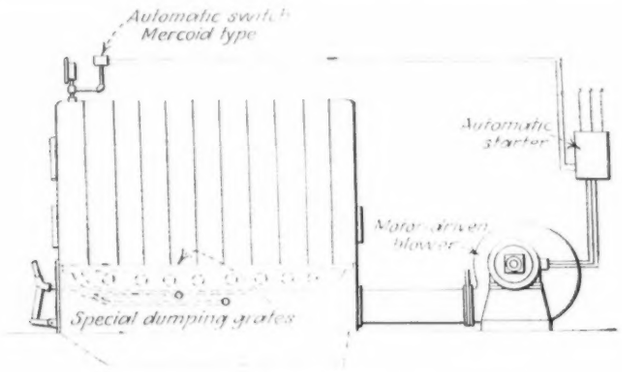
Ques. 10—How are naval torpedoes driven?

Chromium Plating is Receiving Much Consideration for gages and wearing surfaces on account of its extreme hardness; and for exposed parts on account of its high luster and resistance to tarnish. Chromium coating, if porous, does not furnish the same protection against corrosion of any exposed iron as does zinc and cadmium. It does, however, add to the protective value of the copper and nickel coatings over which it is usually applied.—*From a paper by William Blum before the American Chemical Society.*

Heating Boilers Burn Small Size Anthracite Efficiently

By I. R. Hoffman
Combustion Engineer, Buffalo, N. Y.

During the last year and a half a great deal of attention has been given to the idea of burning small anthracite in low-pressure heating boilers. A large number of cast-iron and steel firebox boilers of varying sizes have been equipped with efficient systems for burning rice and barley coal, the smallest sizes of anthracite prepared for the market, commonly known as "steam sizes." The equipment consists largely of special anthracite dumping grates, direct-connected motor-driven blower and automatic starting and switch. In western New York State alone several cities are changing from bituminous to anthracite-burning equipment in the heating boilers of the schools. The large number of office buildings, churches, laundries and apartment houses installing this equipment indicates in a marked degree the serious thought being given to improved firing methods for smaller boilers. Undoubtedly, there is a decided trend toward the use of equipment that will result in the utilization of these cheaper sizes of anthracite where



Arrangement of equipment for burning steam-size anthracite

bituminous or chestnut and stove coal were once a matter of ordinary practice.

It remained for the excellent work of Smoke Abatement Bureaus to help the elimination of smoking stacks, so procuring cleaner air for the city dwellers. Smokeless operation resulting from the use of anthracite fuel, in large and small boilers, has made city atmospheres as clean as country air, and purged the downtown districts of soft-coal smudges and dirty hazes, once so prevalent a condition. Even the smaller heating boilers, whose use of bituminous was at one time ignored, are now compelled to use anthracite.

In spite of the smokeless advantages of anthracite, its use could never have been furthered but for the savings possible over operation with bituminous coal. In the past heating season a six-hour test was run on two cast-iron sectional boilers each rated at 9,000 sq.ft. of radiation. The fuel used was anthracite-barley having a heating value of 11,720 B.t.u. per lb. as fired.

In each boiler were installed 23 sq.ft. of special anthracite dumping grates of sectional top design having $\frac{3}{4}$-in. slotted air openings. The total area of free air openings through the grates was 1.63 sq.ft. Each boiler was equipped with a blower capable of delivering 1,250 c.f.m. at 2 in. static pressure, direct-connected to a 2-hp motor running at a constant speed of 1,450 r.p.m. A blast gate on the intake controlled the amount of air supplied by the blower. An automatic mercoid switch was installed in the circuit of an automatic starter for the motor. These controls acted to shut off the motor when boiler pressure rose above the desired point and started the motor when boiler pressure dropped below the pressure desired. During the test the boiler pressure was kept practically constant at 6 lb. gage.

The total load on the boilers, both of which were in operation, was calculated at 14,000 sq.ft. of radiation. The total coal consumed in 6 hours' operation was 2,940 lb., or 490 lb. per hour. Each boiler took 245 lb. per hour, which indicates a combustion rate of $10\frac{1}{2}$ lb. of coal per square foot of grate area per hour. Estimated evaporation was slightly over 6.7 lb. of water per pound of coal as fired. This is equivalent to a combined boiler and furnace efficiency of 66 per cent, using actual figures. When these boilers used bituminous coal, the years previous, the best they could do was 55 to 58 per cent.

During the test it was observed that firing was required at 35-minute intervals. It was also noted that the intermittent operation of the blower totaled $2\frac{1}{2}$ hours. The idle time was $3\frac{1}{2}$ hours, but the alternating periods of operation and shutdown were not constant.

If it is desired to compare the operation of these boilers with that of power boilers, if such a comparison is possible, it may be stated here that 1 sq.ft. of steam radiation requires 240 B.t.u. per hour, and 10 sq.ft. of boiler surface is equivalent to 33,479 B.t.u. per hour. This means that 139 sq.ft. of steam radiation may be considered the equivalent of 10 sq.ft. of boiler-heating surface. Thus the heating boilers tested are equivalent to a power boiler having 65 sq.ft. of heating surface.

Banking with Steam-Size Anthracite

The question is still raised as to the possibility of banking steam-size anthracite fires for eight to ten hours. Anthracite barley and rice fires are easily banked for periods as long as twelve hours. It is first necessary to form a thick incandescent fuel bed and, before leaving at night, to fire in a large amount of coal on the rear half of the grates. The entire fire should be covered, however, leaving just a small bare area of fire in the front of the furnace. Close the drafts but not the damper. There will be sufficient infiltration of air through the blower casing, for combustion.

To bring the fire out of a banked condition, turn the blower on for fifteen minutes. Shut it off and clean the fire, spreading the incandescent fuel evenly over the grate. Cover the fire with a thin layer of coal and turn on the blower; or, let the automatic controls do their duty. Continue to fire lightly and cover up any holes in the fire until the fuel bed is built up to a thickness of three or four inches.

The illustration shows the general arrangement of equipment making up a combustion system for small anthracite. It is not practicable to use a variable-speed motor-driven blower unless direct current and a rheostat are used. In churches and auditoriums it is advisable to set the blower on a cork base to eliminate vibration noises, and care should be taken to keep the blower speed under 1,500 r.p.m. When the blast gate is installed on the outlet of the blower, a little less noise will result, although the blast gate on the intake makes a more convenient job during installation.

Some Notes on Steam Turbine Development

IV—Some Modern Developments in Design

By W. J. A. London

THE increased operating pressures and temperatures have brought about a modification of design not only in the main parts of the turbine, but in the smaller details such as casing feet, piping and exhaust connections. Mr. London traces the development with examples from practice.

MODIFICATIONS in design, necessitated by the increasing operating pressures and temperatures, have not been confined exclusively to the larger or main units. The construction of auxiliary and mechanical drive turbines had to be radically modified to adapt them to modern practice.

The necessity, for instance, of all-steel casings, or steel steam rings, has required careful design in order to procure sound castings. The most radical change, however, has been in the location of the casing feet. With comparatively low temperatures these could be placed at the bottom of the casing without serious expansion troubles, but with temperatures of 700 deg. the center line of the turbine may be raised ⅛ in. or more above that of the driven apparatus, an amount sufficient to introduce serious misalignment complications.

Fig. 1 shows a typical small turbine that was perfectly satisfactory some years ago, and Fig. 2 illustrates the changes that have been made in the location of feet.

A return to the multi-cylinder construction used in the early 1900's is a rational step, bearing in mind the temperature drops now in vogue. We are, of course, discussing land practice only at this time, it being remembered that the dividing up of the pressure drop into a series of complete independent turbines originated in the modified turbines installed in the experimental steam yacht "Turbinia" in 1896. High, intermediate, and low-pressure cylinders were adopted, each connected to an independent shaft. The compound system has been standard marine practice ever since.

The year 1913 saw the beginning of the return to the multi-cylinder design for land work in this country, when the installation of the 25,000-kw. Parsons machine was made at Fisk Street. From this time on, several other machines of the two-cylinder design were placed in commission by the Westinghouse and General Electric companies. The next notable step along these lines was when the 60,000-kw. three-cylinder, three-shaft machines were installed at the Interboro Station in New York in 1918.

A logical innovation, made possible by distributing the expansion over a series of separate casing units, is the superimposed cylinder design, as shown in Fig. 3, with the entire elimination of dummy pistons.

Reference has already been made to the external

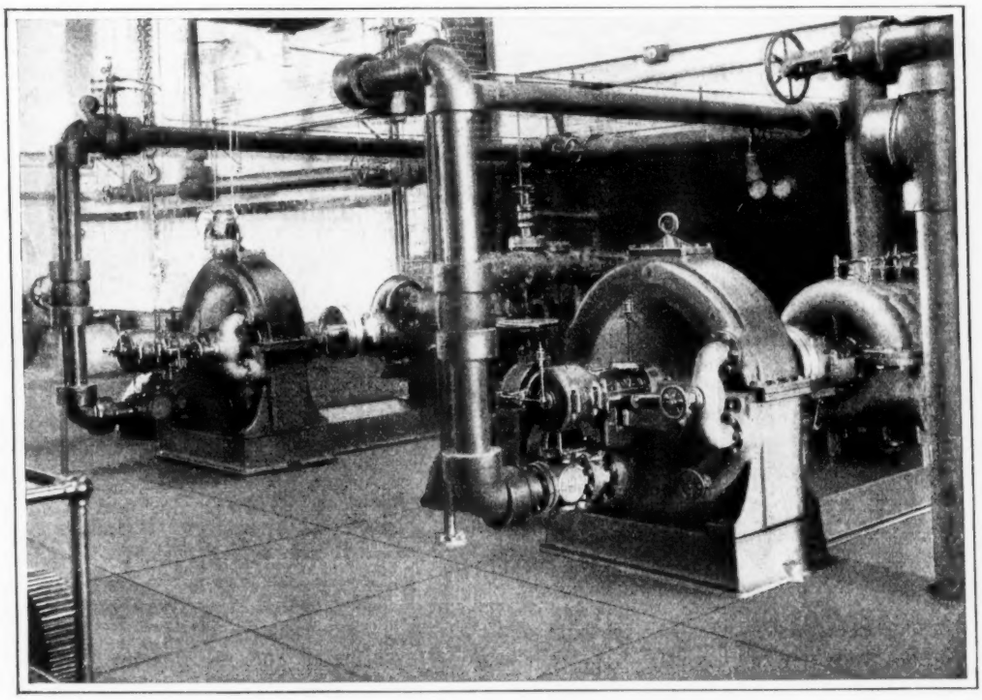


Fig. 1—Small turbine of some years ago, showing location of casing feet

stresses which the casing must be designed to withstand. The distorting effect of the steam pipe itself was at one time a matter calling for serious consideration. In the straight Parsons type the steam pipe was connected to the smallest diameter, and point of minimum blade clearance, so very little strain due to expansion or bad fitting would be sufficient to impair seriously the satisfactory operation of the machine. Manufacturers had to insist upon the customer's submitting his piping layout for approval; but while the builder might agree that the layout as submitted by the purchaser was satisfactory as far as elasticity was concerned, it did not overcome the difficulties sometimes encountered by stresses set up due to bad pipe fitting.

A satisfactory solution to this problem was the introduction by several makers of a flexible pipe as an integral part of the turbine proper. This pipe leads from a rigidly supported steam chest or throttle valve to the casing.

The exhaust connection presents a much more serious proposition. The exhaust chamber in the casing itself is necessarily of a very unsymmetrical formation, and this must be bridged in such a way that it will resist the enormous atmospheric load, so that true alignment will be maintained between the blading barrel and the outboard bearing.

The logical method of accomplishing this is to

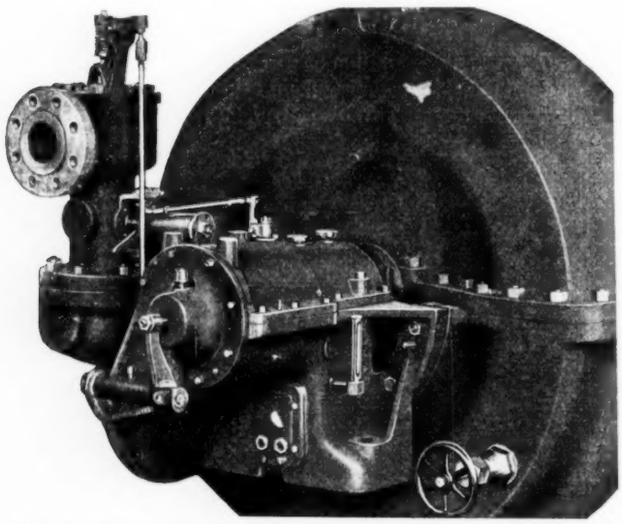


Fig. 2—Location of feet in modern design of small turbine

insert heavy ribs across the exhaust opening to give enough beam section to resist bending. Indiscriminate ribbing, however, as used in the earlier designs, must be avoided as another important factor must be taken into account.

The demand for the highest possible efficiency, and an appreciation of the energy that can be lost between the last row of blading and the condenser, naturally led to extensive research work to reduce these *leaving* losses, as they are termed, to a minimum. Consequently, the exhaust hood is no longer just an outlet for the steam but a carefully designed chamber, so that the last fraction of an inch obtained by the condenser (and paid for in the condenser) can be converted into useful work in the blading.

The measurement of the actual "operating" vacuum (if we may use such a term) at the turbine exhaust is by no means an easy one to make. A mercury column

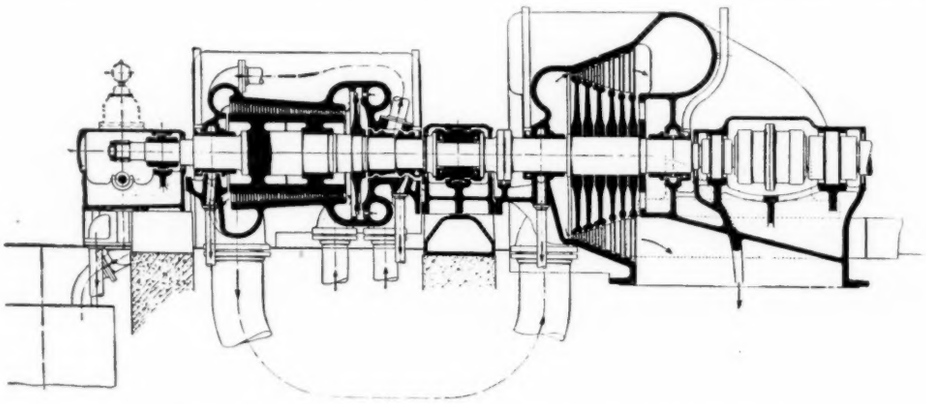


Fig. 3—Example of superimposed cylinder design with elimination of dummy pistons

connected to the wall of the turbine may give misleading figures, in no way truly representing the mean vacuum in the exhaust pipe.

The steam flows from the last row of blades in a path parallel to the shaft only with one certain stream flow. Under any other condition the steam will have a certain whirling motion either with or against the direction of rotation, depending upon the load and efficiency.

A certain whirling motion is also produced by the friction of the steam against the last disk, the amount of this depending upon the diameter of the disk and its relation to the volume of steam.

In returning to the question of ribbing the exhaust opening, it is obvious that where there is any whirling of the steam, these ribs can, and actually do, cause considerable eddying in an exhaust hood of restricted area requiring high velocities.

In all the earlier designs we find that while the exhaust pipe provided was of sufficient area to allow for a reasonably low velocity of the steam to the condenser, the entrance to this pipe was restricted by the blading barrel projecting into the exhaust hood. The steam had to turn corners and go through a considerable number of convolutions before it found its way out.

With this condition existing, any ribbing at all naturally produced eddies. Searching tubes have found a difference of one inch or more in the vacuum between the two sides of these ribs.

In machines of moderate size it is possible to eliminate the ribs altogether in the exhaust chamber and substitute suitable tie rods, but in the large machines the load is so enormous that substantial ribbing is a necessity. In modern practice, however, we find particular care being taken to provide a smooth passage from the blades to the condenser, at very low velocities, thereby reducing eddy losses to a minimum. Fig. 4 shows a typical example of the latest practice in exhaust-chamber design.

Velocities of 400 to 600 ft. per sec. in the exhaust, which was common practice some years ago, are now reduced to half of these figures or even less.

A natural trend in the development of design has been

to bring the actual tube surface of the condenser as close to the blading as possible. One example of this is found in the 25,000-kw. Parsons machine installed at the Fisk Street Station of the Commonwealth Edison Co., Chicago. The old vertical design certainly had advantages along these lines, the steam actually entering the condenser without having to turn any corners. However, the tubes were too close to the blading, and the initial hood in its relation to the leaving losses in the simple turbine. The magnitude of the leaving losses taken as a whole, however, must take into account the performance of the last few rows of blades in conjunction with a properly designed discharge chamber. This has led to some radical modifications in the construction of the whole low-pressure element.

A low-pressure combination of unusual interest was

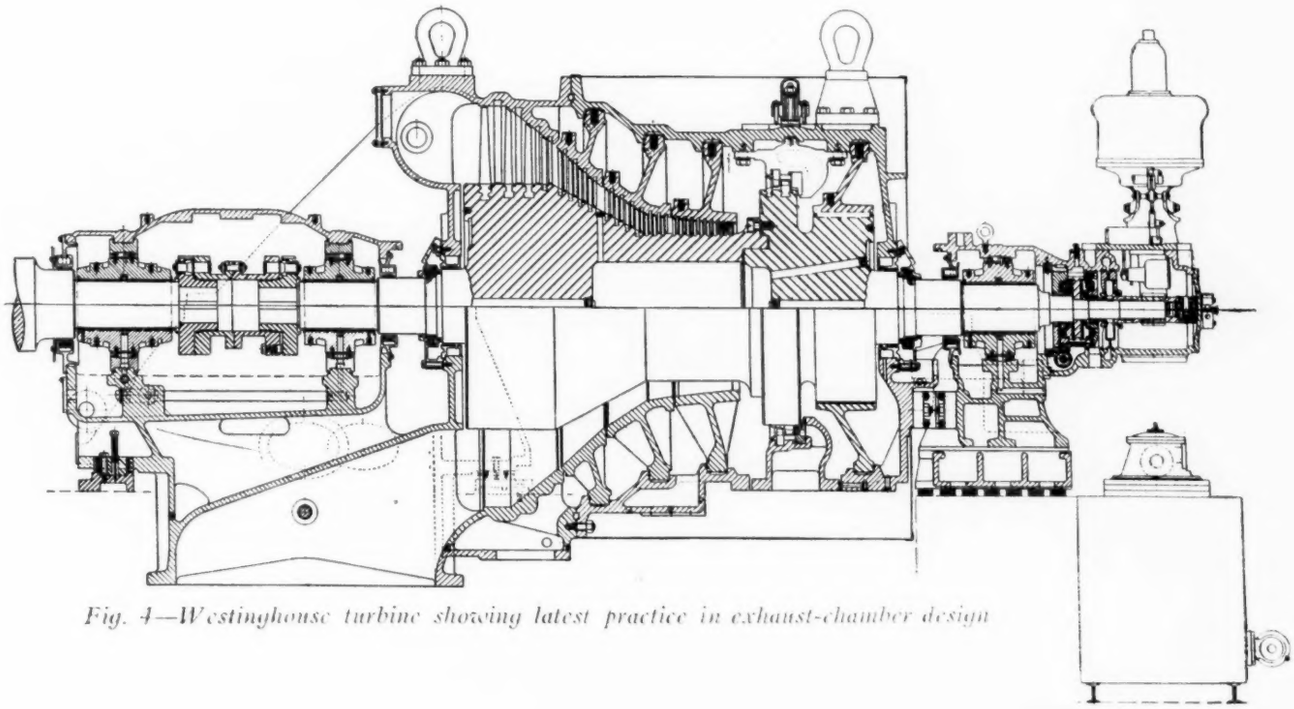


Fig. 4—Westinghouse turbine showing latest practice in exhaust-chamber design

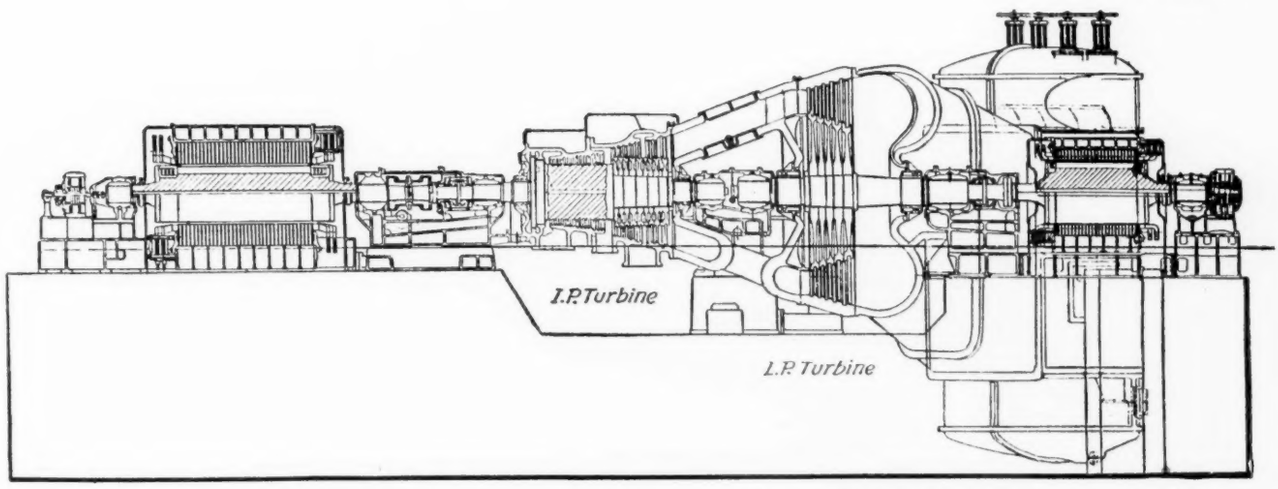


Fig. 5—Intermediate and low-pressure unit of Parsons turbine installed in Crawford Avenue Station of Commonwealth Edison Co., Chicago

tubes were subjected to high local velocities of the steam leaving the blades, suffering in consequence.

A close approximation to the foregoing ideal condition is found in the turbines installed at the Crawford Avenue Station of the same company, where twin vertical condensers are used, these being practically built into the exhaust heads, but with just sufficient space intervening to reduce to a low figure the velocity actually striking the tubes.

In this discussion we have considered only the exhaust

introduced by the Parsons company in its design of the 50,000-kw. machine for the Crawford Avenue Station, as shown in Fig. 5. The turbine is of the three-cylinder type with three generators. The high-pressure element, complete with its own generator, comprises one unit. The steam is then led through a reheater to the intermediate stage, with its 30,000-kw. generator, and from there to the low-pressure cylinder connected to a 5,000-kw. generator. The intermediate- and low-pressure elements, being mounted in one straight line, present the appearance

of one single turbine with a generator at each end. It is the design from the intermediate stage to the condenser that is of special interest. While mounted in one straight line, as already mentioned, the intermediate-pressure and low-pressure shafts are in no way connected, but run at different speeds, the former at 1,800 and the latter at 720 r.p.m.

It may be seen, by referring to Fig. 5, that the steam is led from the intermediate-pressure to the low-pressure stage through a conical passage, the steam entering the low-pressure turbine blades without shock. The low-pressure shaft permits the use of standard blade heights by using large angles but still adhering to the single-flow construction. The steam leaving the last row of blades has to turn an angle of only 45 deg. on its way to the condenser.

The Baumann system of low-pressure blading, first introduced in the turbines built by the Metropolitan-Vickers Co. in England, was another step toward reducing the leaving losses or, to be more correct, toward increasing the efficiency of the extreme low-pressure end of the turbine itself in conjunction with a well designed exhaust outlet.

This system is used in this country by the Westinghouse company. In the Nov. 30, 1926, issue of *Power* some good illustrations were shown of this arrangement as applied to the 80,000-kw. turbine at Hudson Avenue station.

Answers to What Do You Know

The questions are on page 431

Ans. 1—An eccentric is, in fact, a crankpin that is so large as to envelop the shaft. For imparting a smooth reciprocating motion the eccentric form of a crank is preferable, because the necessary bearing surface takes up less length along the shaft, the crank motion is obtained without cutting away or reducing the strength of the shaft, and may be made adjustable lengthwise on the shaft and also in angular position with respect to the main crank or other parts carried on the shaft.

Ans. 2—If the water is very muddy, the boiler should be blown down several times a day and preferably during intervals like morning, noon and night, when the boiler is doing the least steaming. If blowing down is done only once a day, the best time is in the morning or after the longest interval of rest and before the settled sediment becomes too much stirred up by the circulation during active steaming.

Ans. 3—The principal advantage is derived from prevention of initial condensation. The higher the degree of superheat the drier the steam at cutoff, and by sufficiently superheating the steam supplied to an engine, it is possible to prevent any cylinder condensation and deliver dry or superheated steam during the exhaust. By using superheated steam, single-cylinder engines which are subject to large losses from cylinder condensation when supplied with saturated steam, may be operated successfully through a greater range of expansions and such an engine may be run economically with either a light or a heavy load.

Ans. 4—A 20-ton refrigerating machine is one that produces a refrigerating effect at a rate equal to the melting of twenty-tons of ice per 24 hours. A pound of ice in melting requires a quantity of heat known as the latent heat of fusion, which amounts to 144 B.t.u., and twenty tons of ice would absorb $20 \times 2{,}000 \times 144 = 5{,}760{,}000$ B.t.u.

Ans. 5—Small valves have less lift and therefore can open and close quicker and are subjected to less wear from pounding on their seats; there is less friction, and the shorter studs or spindles are less likely to become broken from shocks or unequal distribution of pressure. A number of valves are not likely to be seated at the same time, and less shock is thereby imparted to the valve deck than when a large valve comes down on its seat. Small valves are cheaper to construct and repair, and the valve seats are easier to replace than those of larger valves.

Ans. 6—The main difference is that Trick's valve affords double admission. Live steam is admitted past the outer edge of the valve just as with the ordinary *D* slide valve and additionally through a passage in the valve leading from the opposite side of the valve. When the outer edge of the valve uncovers the port for admission, the port of the passage at the opposite end of the valve is also uncovered, thus giving a double admission of steam, the same as a double-ported valve. This valve does not, however, give double exhaust, as the passage is not open to the exhaust.

Ans. 7—For belts up to 10 in. wide, make the splices 10 in. long. Belts that are 10 to 18 in. wide should have the splices as long as the belts are wide. Eighteen inches is the greatest length required for the splice of a double belt.

Ans. 8—A left-hand adjusting screw affords greater convenience in closing up the jaws of the wrench by operation of the milled collar with the thumb while the wrench is held in the grasp of the fingers of the right hand.

Ans. 9—Yes. The multiple-effect evaporator is based on the principle that the condensation of the initial pound supplies heat to evaporate almost a pound of water, the vapor of which is then condensed and in doing so evaporates a second weight of water at a lower pressure. This may continue in a number of stages.

Ans. 10—Each torpedo contains a tank holding air at high pressure. This is fed to a special boiler along with oil. Steam is generated at high pressure and along with the combustion gases drives a turbine.

ARCHIV FÜR DAS EISENHÜTTENWESEN is a newcomer in the magazine publication field, whose first issue appeared in July, 1927. It is published by the Verein deutscher Eisenhüttenleute at Düsseldorf as a supplement to their journal *Stahl und Eisen*. The contents are to appear under six groups: (A) Pig-iron production, including ore questions, coke, and foundry plant operation; (B) steel production; (C) rolling mills and fabricating plants; (D) power, heat and machining plants; (E) metallurgy; (F) management. This publication, which carries no advertising, is printed in splendid fashion on high-grade paper, and is so made up that each article begins on a right-hand page, so that the reader who desires can separate the articles for filing, without the necessity of copying any material and without losing anything. The two issues that have thus far appeared give promise of a splendid future of usefulness to all those who may be interested in the steel industry and its allies.

What Would You Do?

By S. A. Enge

A Continuation of the Discussion on What Would You Do? Which Appeared in the June 28 Issue, as Viewed by a South American Engineer

THAT night after my conversation with Bill, I could not help thinking he was hopelessly "treed." And, what was more, he had run out of ammunition and could not summon up enough mental energy to plan a different line of attack.

In my own mind there seemed no other course for Bill than to make the recommendation to buy both power and process steam. His boiler settings were shot, and his generating equipment already heavily overloaded, making it physically impossible to run against a back pressure. Many an old dump had been resuscitated, but this one was beyond hope. Bill was right, the new combination would be far too economical to permit entertaining the idea of revamping the old equipment.

Further, if Bill was going to make any kind of dignified exit, he would have to put the proposal before his company, getting just that much credit for himself. He was in duty bound as an engineer to work for the best interest of his employer, even if such were detrimental to himself. His company might accidentally get to know of the plan that had been studied. Professional advice could be called in, when Bill's position would be far worse, since he has failed to study and propose the advantages himself.

A hundred and one ideas ran through my mind, but they all ended in the same resolution, namely, that the new plan was of such an economical nature that it cancelled all prospects of putting old obsolete equipment in shape. Bill, on the other hand, had been in the place so long that he looked with dread at the idea of seeking another position. It sort of made him look at the wrong side of life. His big guns were silenced. He was retreating. Bill and I had been friends many years, and we had always shared each other's troubles. On this occasion I was going to help him if I could. Buried in thought, I fell asleep.

I suddenly found myself in the presence of Bill. Instead of the sorrowful figure of yesterday, I now found him full of pep. He slapped me on the back, making my neck snap, saying simultaneously, "I've got it, boy. It's doped out. Sit down and I'll tell you all about it."

From the way he looked at me, I thought he had either gone mad or he had got a new supply of ammunition. I had plenty of assurance that the fireworks would start sooner than I anticipated.

"Look here, Fred," he said, "I've been in this joint for over twenty years and if I am in a pickle it's my own fault. Had I been wide awake all these years, the old man would have died leaving behind a modern motive-power department, with me sitting on the throne marked Chief Engineer and pulling down the dibs instead of looking for a job. Get me, Steve? Had the old man not loosened up, well, off to somebody that would. Fred, the money we have lost running this dinky machinery all these years would have bought two new installations, but enough said; here's my plan.

"You know the old man with the game leg? Yes, that's him. He came strolling around this morning when I assaulted him with something like this: 'Look here, Mr. Rip Van Winkle, I've something up my sleeve which will mean 8,000 bucks more per annum in your jeans, plus the saving of your chief engineer's salary.' I must have taken him by surprise, for he looked at me rather kindly and asked if I had taken a stimulant this morning. 'No sir, just natural exuberance'; I retorted."

"Say Bill," I interrupted, "has someone wound you up since last I saw you? Yesterday you were quacking like a dying duck. Today you upset the apple-cart by telling Rip——"

"Oh, shut your trap," remonstrated Bill, "you're backfiring about every other revolution. 'Yessir, 8,000 bucks, stimulant or no stimulant,' says I to the old man.

" 'Before you became the owner of this plant, I studied a plan whereby purchased current from a power company and exhaust steam from your next door neighbor for processing would save the firm that amount. Once installed and running, you will have no further need of an engineer; then I'm shaking the dust of this place off my heels.

" 'Sounds good,' ejaculated the old man, 'but don't go too fast. We are running smoothly and making money, and while such a saving is very welcome, we want to make sure that continuity of service and a reasonable amount of independence is going to be part of the program. What about the old installation?'

" 'Here's the proposal which explains everything, and figures don't lie,' I said. 'The power company is as good as gold, and your next door neighbor's offer is as solid as the rock of Gibralter.'

"The old man grinned, pocketed the manuscripts saying, 'I'll see you when I've looked them over. In the meantime, look after the plant as usual.' "

Bill seemed a terror on wheels. So unlike him to be acting like this. Generally he was meek and mild. He seemed more like a crusader bent on destruction. His gaze pierced me while he said, "Fred, I'm glad I'm getting out of here. I have been inactive long enough. Progress has made junk of this place. One thing I am happy about, I've studied and I'm up-to-date, only I neglected to apply it here. My great desire is to economize, for the old man made me see things in just one light.

"I never figured on him kicking the bucket, or anything else. Many a good man has gone in the rut in the same way, only they did not keep the cobwebs off their brains. They just kept on nursing a lot of cripples for a score of years thinking they were doing the right thing, whereas they were paving the way to their own undoing.

"I'm going to look for another job," Bill continued, "and I'm throwing every ounce of my 170 pounds of avoirdupois into the battle front about as quick as the law will allow me. I will be chief engineer of a modern place inside of three months or I'll eat your hat."

"That's the boy," I encouraged him. "With stuff of that grain you'll never starve."

"Starve, man, you must be nutty," he ejaculated. "No man will ever starve who is willing to exchange a day's work for a day's pay."

That ended my dream, for the wife buried her mitt in my ribs saying, "You had better come to and change the scenery."

The next morning I told Bill all about my dream. He agreed it was the most logical thing to do.

Both Bill and I had many a good laugh over the incident and often wondered what would have happened had he chosen to stick to the bitter end at the good old place where he had spent so many years.

Steam Economy at the Peoria Plant of the Commercial Solvents Corporation

How substantial savings were effected in spite of cheap coal and simple plant layout

By Walter I. Nevius

Mechanical Engineer, Peoria Plant, Commercial Solvents Corporation

THE function of a manufacturing business is to make profits, and unless the power plant can show a profit over purchased power, the managers are usually justified in obtaining their power from a public utility. In considering the relative advantages, the cost per kilowatt-hour is often the main consideration, but continuity of service, availability of skilled supervision, and frequently the investment required and local police regulations are deciding factors. In general, any manufacturing industry using low-head heat in its process can make its power advantageously.

The butyl alcohol industry is such an industry. Butyl alcohol is one of the higher alcohols made by bacterial action on starchy substances, usually corn, and used principally as a solvent of nitro-cellulose and various gums in the manufacture of lacquers.

Increased Facilities Demanded

The almost universal application of lacquers to automobiles and its rapidly growing use for railroad equipment, interior decorating and even as brushing lacquers for household use, created such a demand for butyl alcohol that the Commercial Solvents Corporation, the only producer in this country, finding its Terre Haute, Indiana, plant overtaxed, in 1923 bought the Majestic Plant of the U. S. Food Products Corporation at Peoria, Illinois, demolished most of the buildings, converted some to their uses and constructed others. Peoria is in the center of the corn belt, has cheap coal of fair grade, excellent labor conditions and is underlaid with a sixty-foot bed of gravel giving an inexhaustible supply of pure cold water, which is absolutely essential to a fermentation industry.

The Majestic Plant, which is now called the Peoria Plant, had a modern power house with seven 5,000-sq.ft. Stirling boilers; two 1,500-kw. 10-lb. back-pressure turbine-generators with the usual accessories—turbo boiler-feed pumps, mechanical coal- and ash-handling machinery, feed-water softener, air compressors, etc. The water supply came from a 16-in. suction line, 2,800 ft. across overflow lands to the Illinois River and from twenty-one 8-in. drilled wells. The suction line was abandoned, as Illinois River water is not suitable for the process. The power plant, along with the rest of the plant, has been enlarged since the original purchase, the latest extension being finished March 1 of this year. The plant now covers 38 acres, and has a replacement value of several millions.

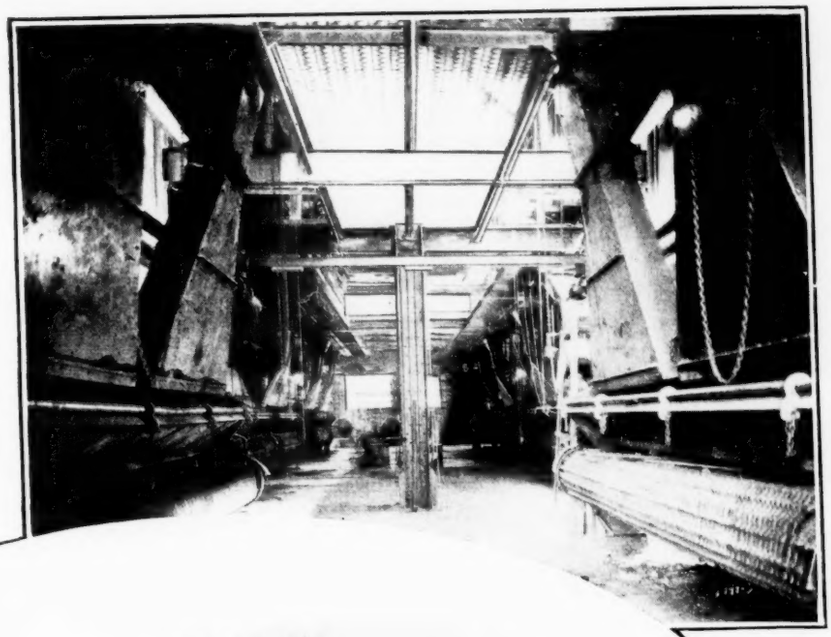
Briefly, the process consists of grinding corn to meal, mixing it in hot water and cooking it under pressure. The cooked metal is blown through double-pipe coolers to 50,000-gal. steel fermenters, where it is inoculated with a pure culture of bacteria which converts the corn to solvents and gas. The fermented mash containing the solvents is distilled in continuous stills, and the resulting crude solvents are further distilled in kettle stills into pure fractions—acetone, ethyl alcohol and butyl alcohol. The gases from the fermenters are converted into synthetic methyl alcohol by pressure and catalysis.

Simple Design Justified

The power plant embodies extreme simplicity. Steam is generated at 190 lb. in eight 5,000- and three 7,800-sq.ft. Stirling boilers with natural-draft chain-grate stokers and two 200-ft. concrete chimneys. The load is steady and coal cheap, and this equipment answers the purpose admirably. Doubtless, additional equipment, such as economizers, air preheaters, superheaters, forced draft, etc., would have made a more efficient plant from the viewpoint of the heat balance, but when the cash balance was considered, it was found that the fixed charges plus the operating and maintenance costs on these refinements exceeded the value of the heat saved, with coal costing less than $2.50 a ton delivered. The feed water is returned from coolers and condensers in the plant at 160 deg. F., heated to 210 deg. with exhaust steam and treated in a hot-process softener, filtered and pumped to a supply tank, where is added the condensate from heating coils in the stills (about 20 per cent of the total). Five boiler-feed pumps (three 400-g.p.m. and two 800-g.p.m.) deliver into a loop system. The feed pumps are all turbine driven, exhausting at 10 pounds.

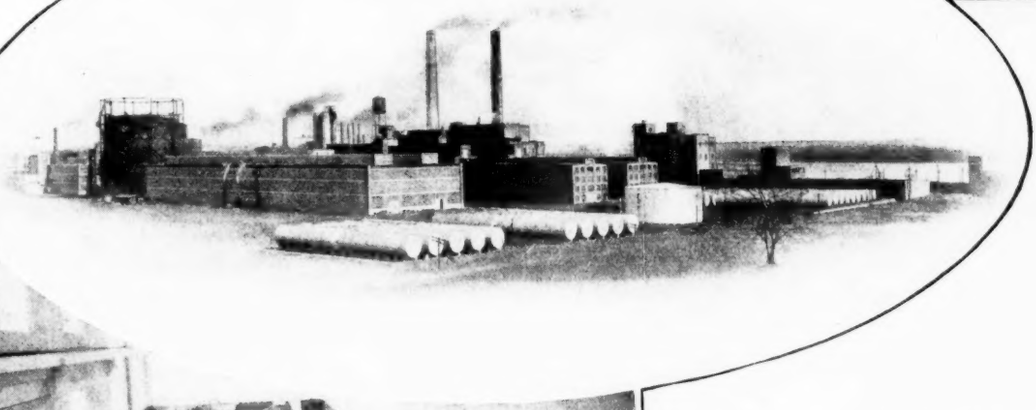
Electric power is generated by one 2,000-kw. Allis-Chalmers turbine exhausting at 25 lb. and two 1,500-kw. General Electric turbines exhausting at 10 lb. Power to each department is metered for cost-accounting purposes.

In addition, there are one 1,500-cu.ft. per min. gas compressor and one 500-cu.ft. per min. air compressor

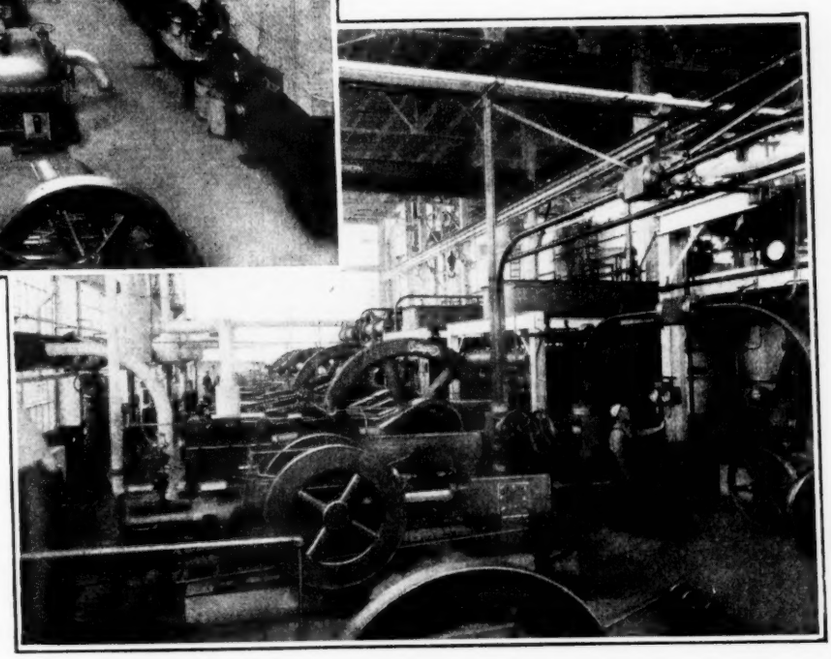


Right—Looking down aisle of boiler room

Oval—Peoria Plant from south end



Left—Engine room containing turbine-generator and compressors



Right—Corliss-engine driven compressors in Methanol plant

exhausting at 10, and one 2,500-cu.ft. per min. gas compressor and one 5,000-g.p.m. turbine-driven plant water pump exhausting at 25 lb. In the ammonia plant there are four twin simple Corliss engine-driven compressors and two smaller compressors exhausting at 25 pounds.

Coal, usually Springfield screenings of 9,800 B.t.u. as received, is unloaded with a 10-ton bucket crane into a 4,000-ton storage yard or direct to the coal crushing and elevating machinery to bunkers in the top of the boiler room. It is also handled by "dropping" the cars into a track hopper from which a 100-ton per hour apron conveyor delivers it to a duplicate crushing and elevating system. Crushers can be bypassed if desired.

Ashes are dropped into dump cars which discharge into pits where the crane picks them up and loads them into railroad cars.

Water is pumped from three 38-in. wells with 2,000-g.p.m. vertical submerged pumps to the suction headers in the power house, where it is boosted with the 5,000-g.p.m. turbine-driven pump mentioned before or two 3,500-g.p.m. motor-driven pumps. All these boosters pumps can pump direct from a system of twenty-one 8-in. wells if desired. The water is clear, free from dirt and bacteria, cold (54 deg. F. throughout the year) but hard.

Many Sources of Waste Evident

When the Peoria Plant was started in January, 1924, all efforts were spent on the production of solvents, both as to quality and quantity. Coal is a very small portion of the cost of solvents, and little attention was paid to it. Exhaust steam at 10 lb. was used in the feed-water heaters and the continuous stills when they were running. If they were down, steam was wasted. All hot water and condensate from the kettle stills was wasted, and the water used for cooking, amounting to 750 g.p.m. over the day, was heated with live steam from 54 to 298 deg. F. Sterilizing operations, heating all the fermenters and pipe lines carrying the cooked corn mash with steam at 20 lb. pressure for periods of two to eight hours daily were done with live steam. Most of the steam lines, even the 24 in. line 500 ft. long carrying the 10 lb. steam were bare. Power-house instruments consisted of coal weighers, which did not weigh, a few pressure gages and a recording thermometer in the feed-water line.

But meters were the last improvement made. The other improvements were so obvious that no meters were needed to show them up, and they were put in at a cost that would have bought two or three meters at the most.

The old porous spiral pipe carrying the 10-lb. exhaust steam was replaced with a welded line and insulated. This created another problem. We were wasting even more exhaust steam, and the answer was some more pipe. The kettle stills, which were heated with pipe coils using live steam reduced to 5 lb. during part of their operating cycle, were connected so they could use the 10-lb. steam also. A few of the buildings require heat, and they were connected to the 10-lb. line.

The cookers are horizontal steel vessels 10 ft. diameter by 22 ft. long. There were ten of these, all bare. These were insulated and connections made so that the steam remaining in them after the mash was blown out could be blown in the mashing tuns through open pipe heaters. The 10-lb. line was connected to these heaters also.

The kettles of the stills are tanks 12 ft. in diameter by 40 ft. long, in which the crude solvents are boiled with closed pipe coils. There are fourteen of these. Insulation again was employed. The condensate from the coils was collected and returned to the boiler feed pumps.

Now we have a 2,000-kw. turbine exhausting at 25 lb. along with seven large compressors and a large general-service water pump. This exhaust is at high enough pressure to carry on most of our operations. It is used for preliminary cooking, all the sterilization and that part of the distillation where 10 lb. is too low and pressure up to 25 lb. sufficient. None is wasted because the plant demand exceeds the power-house supply and some live steam must be added. There are still a few heat units getting away, but some heat exchangers will corral them.

Close Attention to Operation Effects Further Savings

While changes were being made in the power house, operation was being improved. Boilers were cleaned regularly and thoroughly inside and out. Settings were made tight, brickwork kept in good condition, the feed-water treating plant operated on a scientific basis, coal weighers reconstructed, CO_2 meters, fuel gas thermometers, steam-flow meters, draft gages installed on each boiler and steam meters put on the lines supplying each department, cold sampled regularly and analyzed, etc. The technical end of this work, if the technical end of power-house operation can be distinguished from the practical, was in charge of Bentley Brown, steam engineer. Walter Campbell, chief engineer, handled the operation. Luke Schottmueler is master mechanic.

Similar improvements have no doubt been made in thousands of industrial plants and can still be made in others. No expensive instruments are necessary. All that is needed is a thermometer, a watch, sometimes a tank, knowledge of the steam tables and the heaven-born gift of being able to make a logical report to the management showing the expected saving in dollars, together with enough salesmanship to sell the idea to the operators. The realization that they are primarily interested in producing goods and that pounds of steam mean the indication on a pressure gage to the man operating the valves helps a lot. Talk dollars, for they are just as interested in saving dollars and cents as you are, and you will hear less about there being no heat loss in exhaust steam.

Lap Cracks Are Likely to Occur in cylindrical boiler shells along lap seams of longitudinal joints, from repeated bending of the shell plates that results from the tendency for the shell to assume true circular form as often as the boiler is subjected to an increase of internal pressure. This bending is accompanied by a hinging action around the edge of the overlapping plate and may result in the formation of a crack inside or outside of the boiler, on the side of the plate opposite to the side covered by the overlapping edge, or on the same side under or near the overlapping edge. By careful internal and external inspection of the boiler shell along a longitudinal lap joint the full width of the lap, it can be determined whether a crack has formed in the parts of the plates that may be examined, but cracks under the lap, which do not extend clear through to the uncovered surface of a plate, cannot be discovered until the lap has been removed or the joint has become ruptured.

Final Advice on the Heating System by the Service Engineer

By W. Edward

THIS is the last of the series of articles describing the faults found by a service engineer in the heating system of an industrial plant. In it the engineer discusses the provision for pipe expansion, location of radiators, and traps.

THE service engineer had touched on about all the numerous features of our heating system except, as he said, the questions of provision for pipe expansion, the location of our radiation and the trapping of the coils. He therefore proceeded with his enlightening discussion by taking up these points.

"I see that you have two methods of taking care of the line expansion."

"Yes," we said; "there are regulation expansion joints at several points and swing joints that we have made for ourselves at other locations."

"Have you had any trouble with either?" he asked.

We reported that we had, and he answered, "So I thought.

"You have one joint on your main in the pipe tunnel that has been installed in the closed position: that is, from the maker in the closed position are many times installed that way, and I think I have seen so many not anchored that I would be at some trouble to recognize one correctly secured. I have actually seen a few lined up carefully, and yet alignment is as important there as on any piece of operating equipment."

We promised to look into the trouble at once.

"And remember this," he added: "just because an expansion joint does not leak at the end of a heating season, it is not a sign that it does not need attention before the next. I advise that you replace the packing and lubricate the sleeves once each year at least, preferably at the close of each season. You do not have to do this, but it gives the joint a much better chance to function properly.

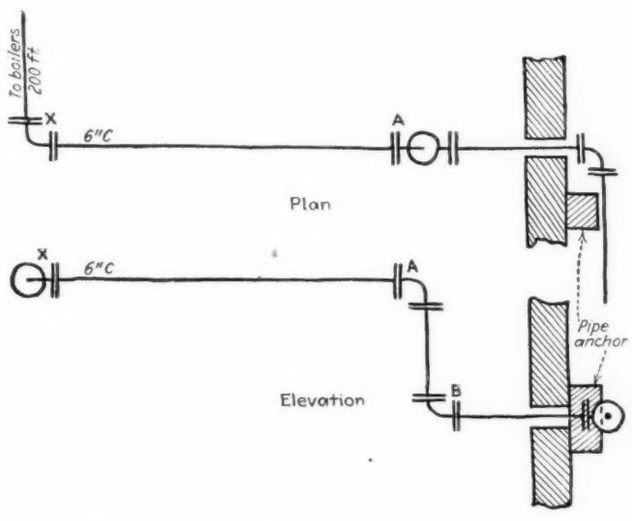


Fig. 1—Pipe expansion caused trouble at X

your pipe was made up so long as to have initially removed all of the provision for movement."

"That is bad," we answered.

"Yes, it is bad. And that's not all. You have another expansion joint that's out of line so far that it is surely bound tight, and yet another that is not anchored as it should be. Doubtless you do not think much of expansion joints as a class, and it's no fault of the joint. The condition on this point in your plant is common to a great many plants. Expansion joints that are received

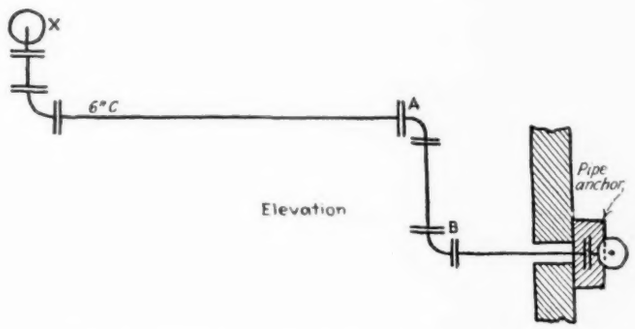


Fig. 2—Piping rearranged to relieve expansion strains at X

"I have checked your expansion swing joints and find that they are all right with the exception of one that is also on the main line. About 200 ft. from the boilers the line turns at 90 deg., runs perhaps 12 ft. horizontally, then turns down for approximately 10 ft., from where it goes out through the wall and through one more turn to the pipe tunnel. Here, let me sketch it.

"That is a dangerous arrangement as it throws a severe strain on the elbow that I have marked *X* in the sketch, Fig. 1. This is because of the long lever arm between *X* and *A*. Movement occurs all right at the flanges of *A* and *B*, but at the expense of a bad bending action in the flanges at *X*. The swing joint, if one is used, should be between *X* and *A*, as I will now sketch.

"The elbow at *X* should look down and connect through a short pipe to another elbow looking toward the wall. The rest of the piping will remain the same

except that the riser between *A* and *B* will have to be shortened. With this arrangement movement can take place between *X* and the elbow next below and in the vertical line threads at *A* and *B*. There will be no dangerous strain with this arrangement."

"Do you find many such arrangements as that of ours?" we asked.

"A great many," he replied. "It is an error very easy to make and one that is made often unless there is a standard sketch from which to work. It constitutes just one more argument for doing the pipe fitting 'from the office' and not from the top of the pipefitter's ladder.

Size and Location of Traps

"The next thing is traps. I am going to touch only on some high spots," he said, "then you can work out the rest of whatever program you may settle upon. You need a lot of traps."

"But every coil and radiator is now trapped," we protested.

"Yes, I'll agree to that, but you have small-capacity traps where large ones are needed. You have bucket traps on a whole roomful of coils, and I have not seen a single strainer or dirt pocket anywhere."

"Not so good, apparently; we thought we were pretty well set on traps."

"Here are my views," he said. "You have one or two of nearly every make, which is the usual result of blaming the traps for the improper functioning of the system. I've shown you some of the things that make the system fail aside from the traps. These should be checked before traps are thought of.

"Let me advise that you check capacity rating on each trap, making certain that it is the proper trap for the service in question. Next make a program to call for a trap on each radiator or coil. Numbers of coils on one trap work sometimes, but more often they shut off on the shortest line and allow the longer lines to choke with water. Then sort your present traps and see how many more are needed. Next, see that a strainer or dirt pocket is ahead of each trap.

Location of Heating Coils

"Finally, we come to the heating coils, the heating-system money spenders. It is queer how you fellows put such a money spender against a wall and then build a bench against it, put a cover over it and choke it off completely. Or how you install a coil where there is no need for one and leave a point of cold air inlet entirely unguarded.

"I have checked your radiation and believe you have more than enough, if you relocate part of it to better advantage and clean up around the rest to give the coils a chance."

This was a surprise to us for we had run everything full blast for several seasons past and had not succeeded in keeping comfortable conditions. We said so and asked what he proposed to do and why.

"In your old group of buildings you have several common center walls against which you have radiation. This is of course a no-exposure position, while cold air must fairly tear down through the big square roof skylights. Remove the coils from those walls and put them up under the skylights."

"But," we said.

"I know just what you are going to say," he replied. "You do not understand how radiation at the roof will give heat on the floor. Nevertheless, try what I suggest and erect the coils flat, not on edge. Provide just enough slant to insure drainage. The point is to have radiation that will cut across the path of incoming cold wherever it may be coming from and to set the radiation so it has plenty of room for air to circulate around it. I venture to say that most industrial plant systems I have seen could increase room temperatures with less radiation if they would locate this radiation in more useful positions.

"Effective heating depends on circulation of air around the coil. How much good then are those radiators that you have boxed in under the benches."

"On this basis, they are not worth much," we admitted, "but tell us what you would do in this welfare assembly room of ours."

"Where do you mean? Oh, yes, the big room with windows on two sides and pipe coils below the window ledges. I had an idea you would speak of that.

"Here is what I would do. I'd move the coils away from the walls to give, say, 2 in. of clearance instead of the present ½ in. At the same time I'd raise them until the top coil is above the window ledge about six inches. From the amount of radiation now installed and the estimated needs of that room, I am certain these moves will correct your trouble.

Velocity Affects Indirect Heating

"There is just one more point, and I have finished. Your men are probably complaining about cold air being discharged from your blower system when, in fact, the heaters are operating full."

"Exactly, but how did you guess that," we wanted to know, for the men had complained.

"There are no diffusers on the ends of the air ducts," he said. "This causes a concentrated flow of air that sets up cold air currents on both sides of the hot air stream. Any one in line with these currents will feel them and say the blower is delivering cold air. By putting on diffusers, that will kill the air velocity leaving the duct, you will end all complaints on this score.

"And now, gentlemen, I've done my part. From here on the work is yours. Check up on the way we have gone at the work. Make yourselves a sort of outline. Check up on all points using the troubles I have disclosed as a basis, and you will have an operating system.

"Provide adequate apparatus, giving consideration to your heating-system needs. It is utterly foolish to buy first-class equipment and put it in before your lines are running as they should, and it is just as foolish to try to get along with a half a system when your lines have been correctly placed.

"Remember that my company has first-class products to offer. Consider them fairly with the others, but give first consideration to your heating-system equipment needs."

Well, now, we hardly knew what to say. Here had been service, real constructive service. We had an entirely new attitude toward our heating system. We do not remember just what we told that service engineer, but we followed his advice and we use his company's products to a considerable extent.

Our system works. It gets a fair inspection at the beginning and end of each heating season. Worn parts are found and replaced, maintenance service being given those that are still good for further service.

Do not assume that rule-of-thumb methods will serve for extensive alteration or addition, and if you can find the service we found, avail yourselves of it.

Removal of Soot

THE removal of soot from the stacks of the Marion plant of the Public Service Electric & Gas Company of New Jersey was always an unpleasant and expensive job until a plan was devised to simplify the operation.

Two of the stacks are designed so that the breeching enters about 25 ft. from the base. Heretofore the soot settling in the base was removed by hand through a door provided for the purpose. This method was found to be not only expensive but unsatisfactory, because the men

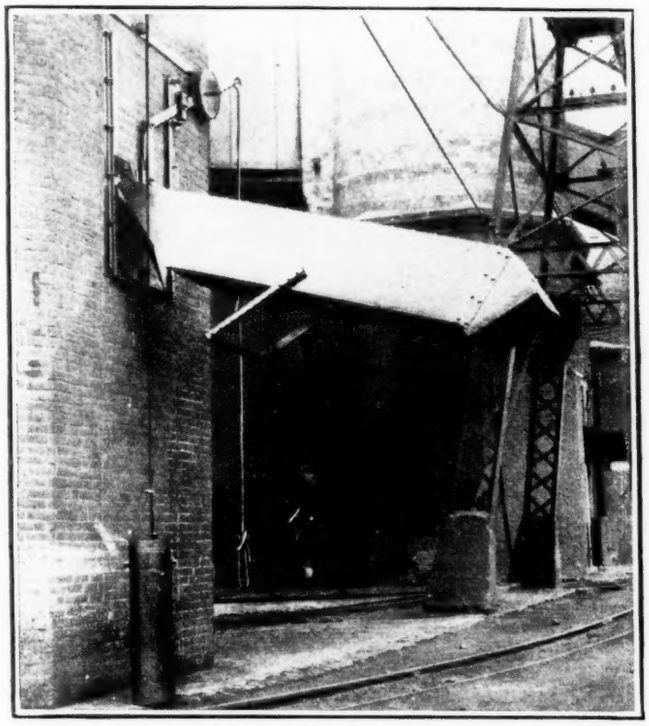


Fig. 1—Symmetrical design and sturdy construction mark the gravity soot remover at the Marion Plant of the Public Service Gas & Electric Company

responsible for the cleaning often failed to remove the soot, and furthermore, it was very rarely done in a satisfactory manner.

To overcome this objectionable feature, a design was adopted whereby the soot could be removed by gravitation. This was accomplished by installing a ¼-in. sheet-steel partition across the inside of the stack at an angle of 45 deg., a sheet-iron sliding door in the wall of the stack at the bottom of the partition, and a hinged chute to carry the soot to the transporting vehicle. The plates of the partition were riveted together and fastened to the wall of the stack by heavy angles. Extreme care was exercised to see that there was not any obstruction that would prevent the soot from settling to the bottom of the plate. The iron door, made of ¼-in. plate, is carried in substantial guides designed for a soot-tight joint, and a free up and down movement. This door is operated from the ground by a rope attached to the end of a ½x3-in. lever 6 ft. long connected to the door through an 18-in. link fulcrumed and counterweighted so that it can be opened or closed with a minimum of effort. One end of a chute with an opening 22x40 in. and 8 ft. long, is hinged above the sliding door, and other end is supported by a ½-in. steel cable passing over suitable pulleys and fastened to a counterweight. This counterweight is just sufficient to keep the chute in nearly a horizontal position when it is not in use, in order to provide suitable headroom.

When the chute is in the full-down position, it is supported by a 2½-in. angle foot which is riveted to its center and rests against the brick surface of the stack.

All parts of this soot-removal equipment have been carefully designed for rigid construction and easy operation.

To remove the soot from the stack, the procedure is as follows: A car is run under the chute and the chute is dropped to its lowest position by means of raising the counterweight shown in Fig. 1 on the ground under the chute near the brickwork. With the chute in this position a soot-tight joint is made between the chute and the door framework. Pulling down on the rope attached to the door counterweight lever, raises the door and the soot flows by gravity through the chute and is deposited in the car. This equipment has been found quite satisfactory and has afforded a means for the quick and economical removal of the soot.

Atlantic Refining Company Reconditioned Tankers

THE "Point Breeze," a 7,000-ton Diesel-electric tanker just completed by the Atlantic Refining Co. at its Point Breeze plant, has had her trial runs and sailed Aug. 29 to Europe, with a cargo.

This boat, originally the "J. M. Connally," was purchased, along with two others, from the United States Shipping Board and was converted to Diesel drive under the supervision of L. M. Goldsmith, technical engineer of the company. The remaining boats, the "Sharon" and the "Bessemer," are being reconditioned by the Alabama Dry Dock & Shipbuilding Co. at Mobile, Alabama, and it will probably be a few months before the next one will go into service.

The former propulsion was of the steam type, but each of the vessels has been fitted with three 850-hp. 225-r.p.m. Ingersoll-Rand Diesel engines, each driving a 525-kw. 250-volt General Electric generator for propulsion and a 50-kw. 250-volt auxiliary generator for excitation and ship's auxiliary power. The propulsion generators supply current to an 1,800-hp. 90-r.p.m. 750-volt double motor direct connected to the propeller shaft. The control is of the variable-voltage type arranged for operation either from the pilot house or the engine room, the control panels being of the dead-front type.

LITTLE ATTENTION IS GIVEN to the cleanliness of direct-current motors and generators in some plants. It is not unusual to see heavy deposits of dust and dirt on the brush rigging and windings, whereas the name-plates shine like mirrors. If the energy expended in polishing these plates is utilized in the removal of the dust the appearance of the machines will be more pleasing and their operation improved. Insulation has a certain definite life and when dirt is allowed to accumulate, premature deterioration will result. These machines should be cleaned on a regular and systematic basis. Not much time will be required to blow out the accumulated dirt with compressed air and wipe off the windings with a clean rag. If this is done, heavy maintenance expense will be deferred and a longer life assured.

EDITORIALS

F. R. LOW, *Editor*

Service

MANY manufacturers maintain an engineering service that benefits the operating engineer and the manufacturer as well. For the operating man it is often the means of solving some of his most troublesome problems, resulting in improved operation and economy. For the manufacturer it serves as an insurance that his equipment is receiving a fair chance, keeps him in closer touch with its actual performance so that if any real faults exist steps can be taken to correct them, and tends to keep a satisfied customer.

This available engineering service is not limited to servicing of equipment already in operation. The engineer with whom is placed the responsibility of recommending or buying new equipment can listen with considerable profit to the advice and suggestions given him by the engineering salesmen sent to him by reputable manufacturers. These men are usually experts in their field and are ready to help in the selection of the proper equipment for the work to be done.

"If you can find the service we found, avail yourself of it," is the bit of advice given at the end of the article, "Final Advice on the Heating System by the Service Engineer," page 441. Both operating and designing engineers can well afford to give serious thought to this suggestion.

Do High Pressures Promote Economizer Corrosion?

IN A report just issued by the Prime Movers Committee, N.E.L.A., one of the member companies in the Middle West is quoted as experiencing considerable trouble through wasting away of economizer tubes, due to sulphur in the flue gas. The rolled joints at the tube ends appear to be the special target for attack. This company operates several stations ranging in steam pressures from two hundred and twenty-five to six hundred pounds, and it has been observed that this trouble is more marked in the high-pressure plants.

That other stations operating with similar equipment at like pressures have reported no such difficulty, has raised some question as to what extent high steam pressure is a factor.

It is conceivable that leakage around the tube ends is more likely to occur at high pressures than at medium pressures, in spite of precautions, and such leakage may not be detected until the corrosive action has set it. It is well known that in certain plants of the Middle West stacks have to be watched closely for signs of corrosion, whereas other plants in that section employing coal of similar quality but slightly different characteristics are practically immune. Sulphur content and mechanical details usually account for the difference.

The subject is one of such importance, in view of the increasing use of high pressures, that steps should be taken to ascertain definitely what bearing they have on the situation. That other companies have not reported trouble is not conclusive that such difficulties have not been encountered. Frank discussion, based on experience, will help.

Redevelopment of Water Powers

MANY of our early industrial developments grew up around water-power sites, as the river served the triple purpose of power, navigation, and when needed, water for process purposes. These developments were usually of small size under low heads. A manufacturer would obtain water rights, construct a dam across the river and provide diversion work to direct the water into the mill. Other manufacturers did likewise, which in time resulted in a number of dams being built across the river and a series of mills located along the water-power site.

All the early drives were mechanical, with water-wheels connected to the driven machines by some system of gearing and belting. As the power requirements for the individual loads were small, the capacity of each wheel was made to conform. Although this system of water-power developments served the conditions that existed when they were made, the over-all efficiency was in many cases very low. A redevelopment of some of these old projects has shown an increase in output ranging from one hundred to about one thousand per cent.

As long as these developments were capable of supplying the power requirements of the community, efficiency was of little consideration, but as soon as the water-power capacity was exceeded, the additional power that might be obtained from the site in an improved development became of economic interest. This is particularly true in districts situated far from the coal fields.

Two of the most serious difficulties in making these

redevelopments are that the water rights may be owned by a number of interests and the water way be used for both process and power purposes. The former may be solved by those holding the water rights pooling their interests in the site and making an over-all development either by forming a separate company or by some arrangement with a utility company.

Where the mills are along the power site and large quantities of water are required for process purposes, to supply this water may seriously interfere with the economic possibilities of the development. This problem is probably not so hopeless as it might at first look, since industrial readjustments are taking place that clear away many of the difficulties in the way of redevelopment. The old industries that were located at the power site are abandoned or have changed their location and leave the site unencumbered for development except for economic and legal limitation. There are instances like these where redevelopments have been made possible, which otherwise could not have been made except at prohibitive expense. These old inefficient developments form an important part of a utilizing program, and advantage should be taken of every opportunity to make them yield their full quota of kilowatt-hours.

Pratt Institute Is Forty Years Old

FORTY years of splendid service in helping young men climb the ladder of industrial survice stand to the credit of The Pratt Institute of Brooklyn, which begins its forty-first year of life on September 26.

Founded by Charles Pratt to aid ambitious men to overcome the handicaps that he had himself so splendidly surmounted, the Institute has long had for its inspiring motto "Be true to your work, and your work will be true to you," and year after year there have come forth from its doors hundreds of men and women imbued with this spirit and equipped with an excellent measure of skill and knowledge imparted through a well-planned and efficiently conducted series of courses in the practical aspects of a wide range of industrial activities.

The school now has enrolled some four thousand students in day and evening courses, half of these in the School of Science and Technology.

The scope of the Institute is little short of astonishing. On the one hand, there are courses in power-plant operation, mechanical industrial practice, electrical applications, chemical technique, and trade instruction in a number of fields. On the other hand are courses in domestic science, and jewelry design and manufacture and library management and a host of things that lead to useful and agreeable occupations for men and women.

The educational facilities of the United States needs more schools like Pratt. There are too many schools aiming to produce managers and supervising engineers and too few training people to do a good job in putting through the day's work and be proud of it.

Power congratulates Pratt Institute on its birthday. Many happy returns.

Power similarly congratulates its readers in having schools like Pratt Institute through whose aid their sons and daughters may discover an intelligent approach to an effective, profitable and happy life in our industrial civilization.

Sources of Evaporated Makeup

MODERN high-pressure boilers should be furnished with absolutely pure makeup water. This enables them to run for long periods at high ratings without danger of trouble from scale or from excessive concentration of soluble salts. Operation of boilers at high ratings requires a lower investment for a given service. This factor is important in the present trend toward the installation of fewer boilers to operate at higher ratings.

When the percentage of makeup is small, it is usually possible to find a source of heat around the power plant that will serve as a heat supply to the necessary evaporators. When the whole or nearly all of the boiler feed is makeup, it is generally impossible to furnish this from evaporators; hence more boilers must be installed to permit operation at the lower ratings necessary with such water. Plants operating under conditions between these two limits present serious problems in providing the necessary heat to evaporators. There are many plants, and among them a large number of small ones, where the necessary evaporator capacity could be installed with slight modifications of existing systems. In other plants every possible source of secondary heat should be studied to determine whether this could be utilized to furnish heat to evaporators.

In some plants the blowoff from the boilers is large. A continuous blowoff system with multiple-effect evaporators would furnish considerable makeup. It has also been suggested that the installation of a heat accumulator might assist in evening out process demands for the boiler when installed with a high-pressure evaporator between boiler and accumulator.

These suggestions are put forward to stimulate engineers to study over their plants and to determine whether evaporated makeup would effect substantial savings and whether it would be possible to secure economically the necessary heat for evaporators from present sources of waste heat.

COLD WEATHER, WITH THE SEASON OF PEAK DEMAND, is approaching and the coal strike still persists, in spite of few outward signs. High production keeps up, although stocks of coal on hand are reported somewhat diminished—to what extent nobody appears to know. In some districts prices have already risen. To what does this point? Those in close touch with the situation see no danger of a runaway market if the buyers will keep their heads.

IDEAS *from* PRACTICAL MEN

Readers are urged to use this department for the exchange of practical operating information. A minimum of five dollars will be paid for contributions accepted

Tools for Maintaining Commutators

ALTHOUGH much has been written on commutator maintenance, I do not believe the subject of trimming the bars has been adequately covered. A simple method will therefore be explained, and the tools described.

It is well, however, to touch on undercutting of the mica in the commutator first. The well-known method of undercutting is to use a hacksaw blade clamped between two pieces of fiber, Bakelite or wood, these being held together by small machine screws so spaced from the edge of the handle that the saw blade rests on them and sticks out about one-eighth of an inch. Such a tool is shown at 1, Fig. 1. These handles can be made any size or shape desired. The saw blade should have its "set" ground off, so that the cutting face is only as wide as at the back. Saws with small teeth give the best results. It is an advantage to undercut a commutator before grinding when the slotting is shallow, since in this way advantage is taken of the old track and the job is easier. The mica should be cut down about one-sixteenth of an inch under the surface of the bar. It is absolutely essential to remove all slivers of mica from the slot.

After the commutator is undercut, it should be ground until it is perfectly round, preferably at normal speed, with a stone held in a lathe-like tool. Fig. 2 shows a

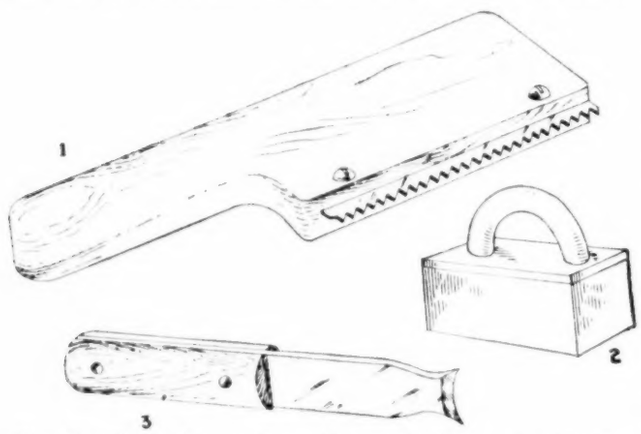


Fig. 1—Tools for undercutting, grinding and trimming commutator bars

pair of stones arranged for mounting on a brush holder. If the commutator is not too rough, however, this can be done with a hand grinding stone, like that in 2, Fig. 1.

The commutator bars should then be trimmed. This is best done with a tool made from a large power hacksaw blade, which is usually about one-sixteenth of an inch thick, three-quarters of an inch wide, and about fourteen inches long. The blade is broken in the middle, then hooks are ground near one end on either side, the end slightly rounded and the inside of the hook ground to a sharp bevel, thus forming the cutting edge 3, Fig. 1. This tool is then honed until very sharp. Starting near the commutator riser, it is hooked into the corner of the bar and dragged through the slot, cutting a clean sliver

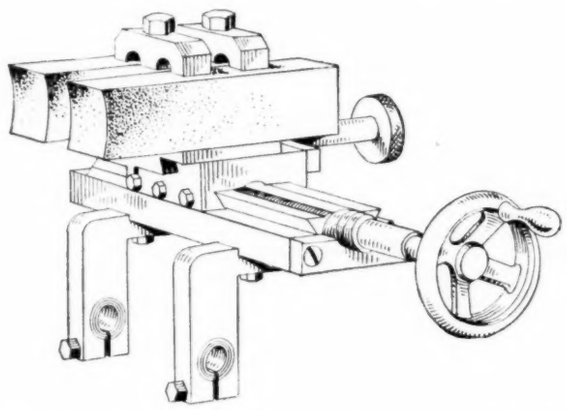


Fig. 2—Grinding tool for mounting on brush-holder

off the corner. This is done on both sides of the bar. Taking off too much should not cause concern because the more open the slot the cleaner it will stay in operation. The commutator should then be polished at normal speed with sandpaper.

In practice it has been found that this treatment of the commutator is quite beneficial to operation. Commutation is better and there is not the usual sharp edge of the bar rubbing against the brush, which undoubtedly causes more brush wear.

E. J. Sacco,
Chicago, Ill. Westinghouse Elec. & Mfg. Co.

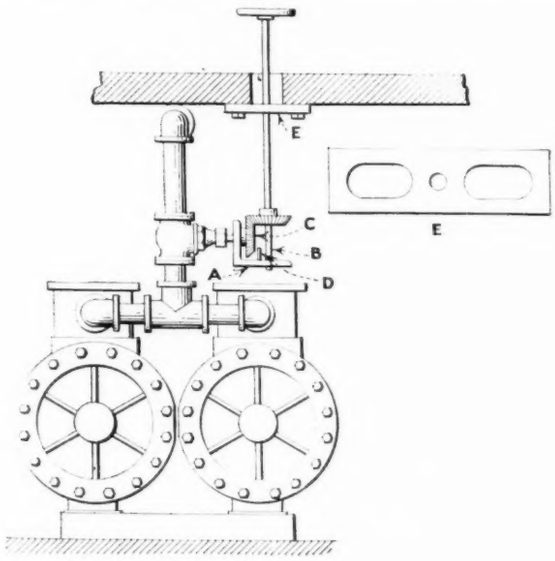
Arrangement for Operating Feed-Pump Throttle Valve from Floor Overhead

SOME rather impractical and inconvenient arrangements of power-plant equipment are frequently found when making the rounds of steam plants. In one instance a boiler feed pump was found located in a pit. The idea was to reduce the suction lift, but no thought had been given to the countless times the fireman would have to go into the pit to regulate the speed of the pump, as no automatic regulator was provided and the steam pipe in this instance did not extend above the boiler-room floor. The arrangement was bad in the first place, and the suction lift was rather high.

However, a new engineer finally came on the job and being rather clever at working out kinks, he made an extension for the throttle-valve so that it could be oper-

ated from above as shown in the illustration. The handwheel of the steam valve was removed and supplemented by a bevel gear. Before the gear was secured in place a bearing elbow *A* was fitted to the valve stem and placed between the stuffing nut and the bevel gear. This piece was made with an easy sliding fit. The outer end was drilled for receiving the end of the shaft *B* and acted as a bearing.

Of course, it was necessary to provide for the move-



Arrangement of right-angle valve-stem extension

ment of the gear *C* as the valve stem was moved in and out in operating the valve. The angle elbow bearing provided for this movement at the bottom end of the shaft, a lug *D* causing the bearing to move as the valve stem moved out and the hub of the gear moved the bearing in the opposite direction as the valve was closed.

Movement of the shaft *B* was taken care of by arranging a bearing *E*, which was secured to the floor overhead. This bearing was drilled in the center for the vertical shaft *B* and at each end a slot was provided so that the bearing could move in either direction. This bearing was secured to the floor by two lagscrews with sufficient clearance between the screw heads and the bearing plate to permit of free movement. At the top end of the shaft *B* a standard handwheel was attached.

Birmingham, Ala. H. J. Mullins.

Loose Connections Cause Motor Troubles

A FOUR-POLE shunt motor developed a case of excessive heating of the armature. Consulting the ammeter showed that the motor was taking an execessive current. No defect could be found on the motor, but a poor contact was located on one of the line cables, where the terminal nut was loose. After a good connection was made by smoothing the terminal and tightening the nuts, the motor ran satisfactorily.

The reason for the increased current through the motor was due to the resistance of the line being increased by the poor contact. This reduced the voltage across the motor's armature and tended to reduce the speed. The voltage across the field coils was likewise reduced, resulting in a small current going through this circuit, which in turn tended to increase the speed. The two effects are such that the motor has still to carry practically the same load, but an increased current will be necessary, which happened in this case. In another case it was found that a loose contact on a fuse terminal of a motor circuit would produce similar results, and also melt the fuses without visible reason.

Terminal nuts are always likely to work loose owing to the alternate heating and cooling, and as the looseness increases so does the heating.

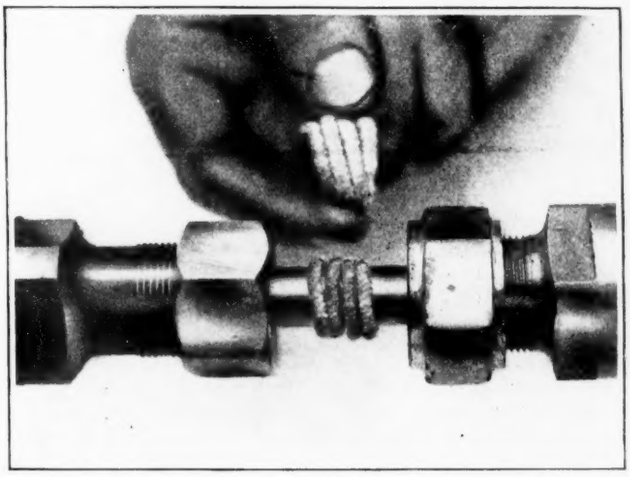
Another case of trouble due to loose contacts was caused on a 15-hp. three-phase motor. This motor would sometimes run correctly, then slow up. Sometimes it would start satisfactorily and again it would run backward, and sometimes it would not start at all unless given assistance. The motor would not carry its load, and the ammeter indicated that it took a fluctuating current. An inspection was made, but no fault was revealed until the star connection in the winding was examined, when it was found to be badly burned and one terminal was nearly off. It was apparent that the motor had been running with an intermittent contact, which caused it to run sometimes as a three-phase motor, then vibration caused the connection to spark, and irregular running resulted. At times the motor was running single-phase and sometimes three-phase. When a good connection was made, the motor functioned correctly.

All motor terminals should be frequently examined. Loosening of terminals on an alternating-current motor often results in the motor running on one phase; this causes the phase to be overloaded and, if not detected in time, will burn out the windings. Cases like this have not been uncommon. Even when locknuts are used, terminal connections work loose.

Bedfordshire, England. W. E. Warner.

Small Piston Rod Oil Swabs

PRACTICAL oil swabs for small piston rods can be made of ordinary smoking-pipe cleaners. The wire in the cleaners permits a close winding around the rod,



Piston-rod swab made from smoking-pipe cleaners

and they set snugly in place. The fabric intertwined in them is tough and easily holds the small amount of necessary oil. The small rods and packing on many small pumps and light machinery is too often neglected because an efficient small swab or rider is rather difficult to make and keep on.

F. W. Bentley.

Missouri Valley, Iowa.

COMMENTS *from* READERS

A "What Do You Know" Answer Is Questioned

WITH reference to Question No. 1 on page 237, answered on page 243, of the Aug. 16 issue of *Power*, I do not agree entirely with the answer, which stated that the noise in a turbine packing gland was caused by water.

Is not the noise referred to caused by the oil used as a lubricant in the packing forming a film around individual drops of water, therefore causing a slight explosive sound? Operators know that this noise is particularly in evidence when a stuffing box has been freshly repacked. After packing has been in use for some time, it loses quite a bit of the lubrication, hence the noise decreases, as you state in your letter.

Louisville, Ky. JOHN F. HURST.

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The Decrease in Students in Mechanical Engineering

REFERRING to the letter of Charles McCabe Smith in the July 12 issue on "The Decrease in Students in Mechanical Engineering," the cause is not hard to locate and the result is appalling. As Mr. Smith says, "The student comes out of the school equipped with a slide rule, a set of drawing tools and a textbook." All three can be bought and used with a little practice. As for the value of a diploma it serves to certify that the student has received a course of instruction satisfactory to those who teach and has remembered enough to pass. Does that qualify him to advise a boy who has graduated from the ninth grade and left the school at the age of 16 and has a 6 or 8 years' start as a machinist, patternmaker or toolmaker? Is it reasonable to expect anyone to learn all that is to be known in the short periods spent in any of the technical schools? It is my belief that our schools will be better when the students study more and the teachers teach less of the nonessentials that cloud the real issues and clog the brain.

Perhaps the value of a cotter pin in preventing a wreck should be stressed more than calculus. The former is an essential element while the later may never be used.

As for textbooks, they are often obsolete before they are printed and the author is seldom an authoritiy as to the actual progress being made. Books are historic records of the past; original ideas are seldom found in them. Lindbergh did not cross the Atlantic as the result of a study based on precedent, but he set a precedent and upset the belief of those who had been on the ground waiting for scientific information. An experienced navigator goes by his instruments plus his expericence with them and the ship he commands. The captain of a ship goes to school to study the theory of navigation. He gets his practice on the use of instruments from those who use them and know how. A book of logs, sextant, and theory will not indicate the force of tides and winds and the ship must be understood and its log records considered.

If a university professor had the education a ship captain must apply, and education means experience, he would be a managing director of some industrial plant earning five to ten times the salary he does. If not, why not? And if a student studied under such ability he might learn the essentials necessary to success. It would appear that the average graduate is the product of a system that is fundamentally defective due to the fact that to teach one must be a B.S., M.E. or some other titled person before he can qualify. It looks to me like a waste of valuable time and money.

Is the average graduate competent to guide his brother who has spent several years doing something definite, while he (the graduate) has spent as many years doing nothing definite and now proposes to cash in his equipment, slide rule, handbook and his experience which means little to anyone who may decide to employ him?

Cleveland, Ohio. JAMES MCINTOSH.

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Deliver Us from Mediocrity

SOME TIME ago I attended a banquet at which the principal speaker was the president of a large corporation, and the greater part of his speech was along the lines of the Foreword in the July 26 issue—"Deliver us from Mediocrity." He spoke at length on the crying need in all lines of industry of men that possessed initiative and would take hold with a whole-hearted interest. He spoke of how the captains were anxiously searching the ranks for any spark of talent that could be fanned into a flame of fitting volume for the jobs higher up.

I was much amused at his speech, for I was no doubt more familiar with his plant and his employees than he was. For several years I had been in daily touch with conditions in the plant and rubbed elbows with probably 90 per cent of the men in all departments. Also, I had on several occasions seen a round on the ladder become vacant and every time some favored son, relative or friend of a stockholder or other official, who had just come from college was given the position, instead of one of the old timers who had had years of experience and was familiar with every detail of the plant and the process of manufacturing—men who had proved their loyalty, interest and ability time after time by suggesting changes that upon adoption saved money and increased production.

Furthermore, in every case the young men that were placed in the positions had to rely on the help and experience of the old timers to help them carry on. And in addition to this, the higher officials would call in the old timers and ask their opinions or advice, when they should have consulted the younger men. This would

seem to prove that the big bosses had more confidence in the old timers from the ranks than the young men they had placed over their heads.

The point is this: Does not the executive know that all his workmen are not dumbells and that they can see this unjust discrimination against themselves or others? Does not the man that indulges in this line of talk know that any mechanic or workman of the present day knows when he has earned promotion or deserves appreciation? Do they not realize that most of their men know that they are practicing one thing and preaching another and that they are taking the surest method they could to kill any interest or loyalty that their men may have? Would it not be better to say less and do more along that line, for it is evident that if a company treats one or more of its employees unfairly, the others will assume that they will receive the same treatment when their turns come.

Wilkes-Barre, Pa. THOMAS M. STREET.

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Better Management of Process Steam

IN THE average industrial plant making its own steam the boiler room should be considered as a separate, complete and self-supporting manufacturing unit—a factory within itself, the product of which is steam.

The revenue by which this "steam factory" is sustained is derived from the "sale" of steam to the other departments of the plant. Each steam-consuming process operated in the whole plant should be charged a reasonable market price for the steam consumed. It would thus become an object for the various plant officials responsible for the profitable operation of the respective processes to see that no extravagance in the use of steam for processing took place.

For instance, it costs more to produce high-pressure steam than it does to generate steam at low pressure or to use for process purposes low-pressure steam exhausted from a high-pressure power unit.

Therefore, if the steam plant charged the process operators a higher "price" for high- than for low-pressure steam, process officials with a proper view to their own interests would naturally prefer, when practicable, to use low-pressure steam. And since many industrial processes can use low-pressure steam to much greater advantage than it can be used in generating power, it is obvious that this arrangement works to the advantage of both process and power plant.

The point is that in many plants the differential between high- and low-pressure steam costs is not made sufficiently clear to the process man. In these circumstances the latter are much more likely to think they must have high-pressure steam or to accept it without trying to get low-pressure steam at a lower cost.

Yet, for instance, if a given process in a specified plant can be operated with low-pressure steam, the foreman might have the choice of "buying" high-pressure steam —reducing its pressure by throttling or regulating valves at the point of delivery—at 80c. per 1,000 lb., or "buying" low-pressure steam, perhaps bled from a turbine stage, at 50c. per 1,000 lb.—assuming that proper provision for suitable piping can be made at an economical cost.

As has been stated, some process officials mistakenly think they must have high-pressure steam, when as a matter of fact low-pressure steam could be made to serve the purpose very well. For example, in a certain plant the use of low-pressure steam was condemned by the process foreman for heating water in a tank because the pressure was insufficient to blow steam into the bottom of the tank against the water pressure. Yet the water would easily have been heated by the low-pressure steam if the steam had been admitted through perforated pipes near the top of the tank, an arrangement provided for agitating the water. Or the water could have been heated by turning the low-pressure steam into suitable heating coils mounted in the tank and fitted with traps for removing the condensate.

It often happens in industrial plants that the conditions of process operation prevent a steady demand for steam by a given unit, and in such cases process operators are frequently careless about completely closing the steam inlet valve, so that considerable steam is wasted. This fact was clearly demonstrated to the management of an industrial plant in which flow meters were recently installed on the steam input lines of the process units. No sooner were the flow meters installed than the plant officials observed that the steam demand strangely persisted even when the process units were "shut down."

Investigation showed the trouble to be due simply to the carelessness of the process operators, who, in shutting down their machines, would leave the steam valves partly open. Following this disclosure, the practice was summarily stopped, with the result that coal consumption of the steam plant immediately fell from 7 to 5 carloads per day. The labor required in the boiler room was reduced and the lower steam demand, of course, lessened the steam charge made against the process supplied.

The management of each steam producing and consuming unit is an individual problem. Measurement of steam output or input to each is an essential factor from the viewpoints of checking expense and results. So, only, can maximum operating efficiency and flexibility be established and maintained, with due regard to the needs of the plant as a whole.

F. V. WETHERILL, Engineering Dept.,
Philadelphia, Pa. The Brown Instrument Co.

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Insuring Power Service

I HAVE read with considerable interest the editorial in *Power* of Aug. 23 on insuring power service.

The installation of the 132,000-volt underground transmission line by the New York Edison Co. is a noteworthy step in the direction of better transmission-line service. It is hoped that it will prove to be a satisfactory installation in every respect. Its costs must be very great, and while it may add to the continuity of the transmitted power, it will probably not decrease the costs of this power when the overhead charges on this additional investment are taken into account.

The reference made to the endeavor that has been made by the large power companies in their generating stations to insure continuous operation is interesting, but as the editorial states, service on the large transmission systems has not been entirely satisfactory.

To make this transmitted power equal to the service that a small individual power plant can render is well-nigh impossible, and with the very large investment necessary in the long-distance transmission lines, the large power companies are up against laws of economics, which make the advisability of transmitted power questionable in many cases.

The investment now in the largest of central-station properties is easily double the cost that relatively small plants can be built for, per kilowatt of delivered power.

Large investments in transmission systems and in stand-by plants must be provided by the large power companies to put their service on a parity with a first-class, well-operated small plant. This causes the central-station plan to lose much of its attraction as a sound financial investment when serving a goodly amount of our industrial power loads.

A reaction back to the private power plant is clearly in evidence in many ways. If continuity of service is not as good with purchased power as that from the private plant, the future outlook for the well-designed and well-operated small plant is indeed promising.

Electricity has been and still is looked upon as a most mysterious thing, and much electric power has been sold which, from a sound economic point of view, might better have remained unsold. The purchasers of this power have in many cases increased their costs, and in many cases the generating stations have not made satisfactory profits.

It is well known to people who are posted on the general power situation that a large amount of electric power has been sold on ill-grounded analyses. The purchasers of this power in numerous cases have been badly disappointed in their costs and have gone back to the methods of private production. As competition increases among the industries, a further reaction in this direction is likely to come.

It is clearly evident that the large power companies are limited in the extent to which they can go for insuring continuity of service.

EGBERT DOUGLAS,
Chicago, Illinois. Douglas & Crytser, Engineers.

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Total Heat—Enthalpy

IN THE columns devoted to editorial comment there appears in *Power*, March 29, an article entitled "Total Heat—Enthalpy," stressing the need of a better name for the quantity known as total heat or heat content.

The article reviews the process by which steam is formed and calls attention to the objections of some individuals who maintain that "external latent heat of evaporation" is not an integral part of the "total heat of steam," and should not be included. It furthermore states that some propose to call this quantity "enthalpy."

It is not quite clear which quantity the name enthalpy is proposed for, but it is known generally that the word has been used to define the "total heat" by some investigators, for some years. In the report of the Refrigeration Research Committee of the Institution of Mechanical Engineers of Great Britain, Oct. 16, 1914, Dr. John Grindley, principal of the Crawford Technical Institute, of Cork, Ireland, and Prof. Weyness Anderson, of Liverpool University, use the word in this sense.

There appears to be a slight oversight in this discussion, and to prevent young readers from gaining a false impression, for which I am sure the editor would never forgive himself, it is well to dissect this discussion and examine the various phases. Before doing so, it is essential that interested parties shall have some conception of the fundamentals of thermodynamics.

The First Law of Thermodynamics specifically states that heat and work are mutually convertible. In other words, a definite quantity of heat can produce a definite quantity of work and a definite quantity of work can produce a definite quantity of heat. If one is expended, the other appears in its place. If we put a certain amount of heat into a process, as in the production of steam in a boiler, all this heat will be used in making steam, but it will not all be used in the form of heat. A part of this heat supplied will be used in the form of work, and as it is heat supplied, it will have to be charged against the process. So it is included in the total heat, although it is not heat actually residing in the steam.

In the Marks & Davis steam table one finds a column headed "Heat of the Liquid." This is the quantity of heat required to bring a pound of water from 32 deg. F. to various temperatures as tabulated, and the table further indicates pressures corresponding to these temperatures. That is, for each pressure there is a definite boiling point at which steam will be formed. The heat indicated must be supplied to bring the water to the boiling point. In some textbooks on thermodynamics this heat supplied to the liquid is divided into two parts, the heat to raise the temperature of the water and the heat equivalent of the work done in increasing the volume of the water. Except for high pressures this latter quantity is negligibly small, and the steam tables include it in the "heat of the liquid."

In any case, from the equation of the first law, the heat added at constant pressure equals the gain in internal energy, plus the work done by the body against external forces, and this is by definition equal to the change in value of the total heat, or enthalpy, of the body. This quantity is established by definition as equal to the internal energy plus APV where A is $\frac{1}{778}$ (to convert foot-pounds to B.t.u.'s), P is the pressure in pounds per square foot, and V is the volume of one pound of the substance.

After the liquid has been brought to the boiling point, further addition of heat at constant pressure will produce no change in temperature, but will be expended in separating the molecules and pushing back the surrounding medium. Again, the heat is performing a double office. The heat applied to separate the molecules and that converted into work in pushing back the surrounding medium are sometimes called, respectively, the internal and external latent heats. In a similar manner, during constant pressure superheating a small portion of the heat applied is converted into work in pushing back the surrounding medium through the expansion of the steam that is being superheated.

When steam confined in a cylinder expands adiabatically under ideal conditions, there is no change in the internal energy due to the transfers of heat, but work is developed at the expense of a reduction in the internal energy of the steam. In the case of an engine or turbine connected to the boiler, the external work expended in increasing the volume of the water or steam just being formed or superheated is helping to push the steam previously formed through the pipes and into the turbine or engine. It helps push it through the throttle valve and ports and nozzles, and it helps to push the piston up to the point of cutoff. Moreover, the exhaust steam must force its way out into the atmosphere or into a condenser. Accordingly, the work done in equipment of this sort is equal to the change in the value of the total heat or enthalpy of the steam.

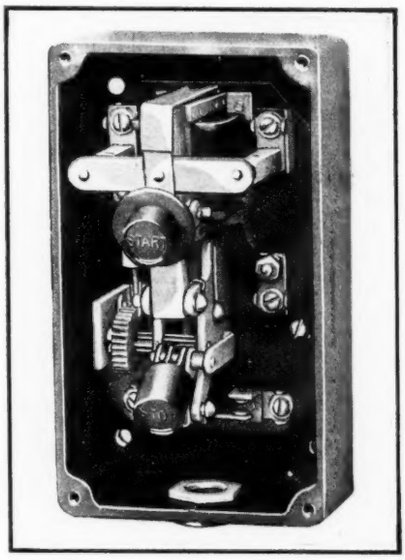
Banks have a system of accounting for each penny, so if we take the total heat going into a machine and the total heat coming out after doing work, and examine the heat drop, we can see how the heat is spent and discover where waste is going on.

F. R. MACNEIL.
New York City.

New and Improved EQUIPMENT

Time-Delay Push-Button Keeps Motors Running

A NEW push-button station for use in preventing the cutting out of motors controlled by a magnetic starter, when there is a brief power disturbance, is announced by the General Electric Co. The station has two push buttons,



Push-button station with cover removed

Start and Stop, and is shown in the figure with the cover removed. This station is used with standard magnetic starters, making it unnecessary to add time-delay attachments to the starters themselves.

In operation, pressing the start button of the push-button station closes the pilot circuit of the magnetic starter and also the circuit of a coil in the push-button station. This coil is part of a lift solenoid and, when energized, causes the solenoid plunger to rise. At the bottom of the plunger are spring-attached contacts which are closed by the lifting action, thus maintaining the circuit through the solenoid itself and also the pilot circuit of the magnetic starter with which the apparatus is used.

If the voltage drops sufficiently to permit the solenoid to release the plunger, the latter starts to fall, but is retarded in its downward movement by a rack which turns a gear. The gear engages a ratchet which can be adjusted for a maximum of 1½ sec. by means of a nut at the end of the rod which serves as a pendulum. If power does not return before the time expires for which the device is set, then the contacts will be opened and both the solenoid and the magnetic starter will be disconnected until the start button is again pushed.

Pressing the stop button stops the motor immediately, because this action opens the pilot circuit of the magnetic starter and likewise disengages the rack of the solenoid plunger so that the latter falls instantly.

International Pressure Discharge System for Steam Purifiers

TO OVERCOME the difficulties usually encountered where a regular external trap is employed to remove the condensation and impurities from steam purifiers connected inside the boiler drum at the steam nozzle and to permit the use of smaller drain pipe, the International Filter Co., Chicago, Ill., has developed the pressure discharge system illustrated herewith.

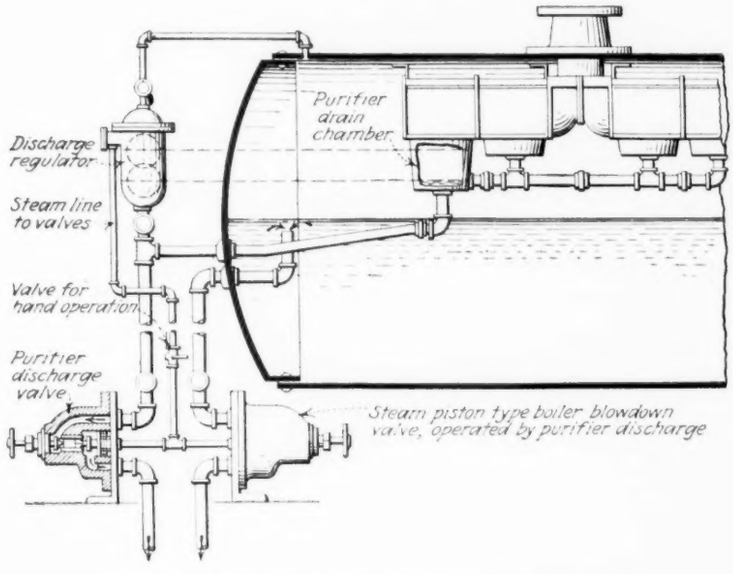
The system consists essentially of an enlarged drip pan under the purifier, an external discharge regulator and steam-operated discharge valve with interconnecting piping.

In operation, when the condensation or waste moisture reaches the high level in the drain chamber and regulator, the discharge valve is automatically opened and the waste moisture is then expelled directly by the steam pressure.

The discharge regulator is essentially the same as a standard feed-water regulator except that the trip valve is slightly modified to provide for intermittent discharges and for water sealing the discharge at the end of each operation.

The discharge valve is of special design. The valve and seat are of monel metal and are readily replaceable. The valve is held in closed position by a steam piston of larger area against which the pressure of the boiler is exerted. The opening of the valve is accomplished by cutting off the steam pressure on the piston, thus permitting the pressure on the underside of the valve to force it open. The alternate cutting on and off of the steam pressure is controlled by the discharge regulator. The design of the valve is such that it closes against the flow, thus removing the working parts from contact with the sludge. An additional feature is an adjustable rate of discharge regulating device built into the body of the valve.

When desired, two or more discharge valves may be operated from the same discharge regulator, as shown in the accompanying illustration. This is done where automatic boiler blowdown is controlled by the moisture content of the steam generated, the proportionment of the two being secured by the rate of discharge adjustment previously referred to.

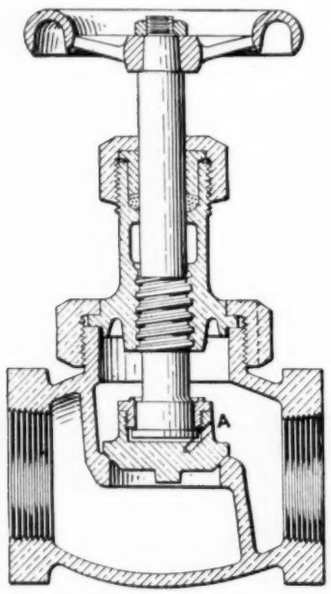

Purifier drain chamber
Discharge regulator
Steam line to valves
Valve for hand operation
Purifier discharge valve
Steam piston type boiler blowdown valve, operated by purifier discharge

Arrangement of purifier with external discharge valve

Ohio Injector Regrinding Valve for 300 Lb. Pressure

THE Ohio Injector Co., Wadsworth, Ohio, has recently added to its line of valves the extra-heavy union-bonnet globe valve illustrated.

The valve is designed for 300 lb. pressure and for service where high temperatures are encountered. The body, bonnet and union nut are of a special bronze and the disk is of nickel bronze. The principal feature in the new valve is the method of locking the disk to the spindle when regrinding. This is done by inserting a pin in the diagonally drilled hole *A* in the disk. This attaches the disk to the stem in such manner that it can adjust itself to the seat while at the same time being made to rotate with the stem.



Cross-Section of Valve

The valve is made in the angle and globe patterns in sizes from $\frac{1}{4}$ to 3 inches.

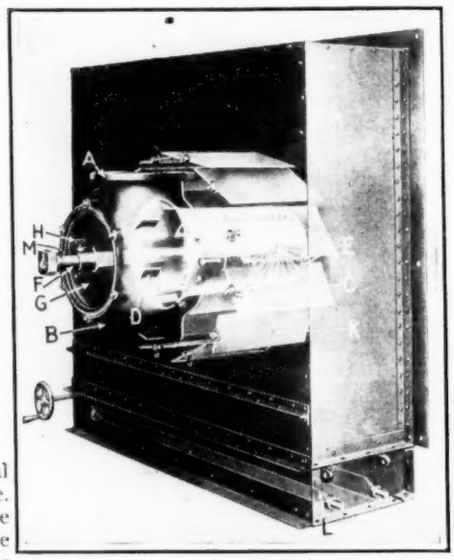
Pennsylvania Air Compressors with "Texrope" Drive

WITH a view to lessening the floor space required and to eliminate the use of an idler as generally employed with the short-belt drive on horizontal air compressors, the Pennsylvania Pump & Compressor Co., Easton, Pa., has brought out a line of compressors fitted with the "Texrope" drive, described in the Jan. 12, 1926 issue. This drive consists of a number of flexible V-shaped rubber fabric belts running on grooved sheaves and permits placing the motor directly on top of the motor frame or in the closest proximity to it.

The principal advantages of this form of drive is that it permits the use of unusually short centers and reduces slippage to a minimum.

Riley Flare-Type Burner for Pulverized-Coal

IN THE new flare-type pulverized-coal burner recently developed by the Riley Stoker Corp., Worcester, Mass., the pulverized coal carried in suspension by primary, or conveying air, enters the chamber *B* through the flanged connection *A*. The stream is given a circular motion within the chamber and enters the pipe *C* while revolving about the axis of the pipe. Since this motion tends to cause the coal stream to travel in a zone adjacent to the inner surface of the pipe, the vanes *D* are arranged to divert the stream toward the center. The coal then passes to the tip of the pipe, completely filling the space between the pipes *F* and *C*. The vanes *E* break the coal streams into a number of stratified streams and divert these strata into a conical form or flare.



Assembled view of flare-type burner

Secondary air, supplied under pressure from a fan, enters the chamber surrounding the burner through the dampers *L* which control the quantity of air flowing, and is given a whirling motion in passing between the vanes *K*. The amount of whirl is determined by the position of these vanes. In general the direction of rotation of the secondary air is opposite to that of the primary air and coal in the chamber *B* and pipe *C*, but they are so designed that they may be set to give the same direction.

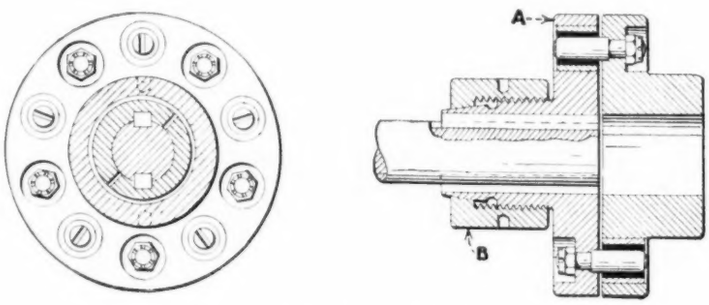
The mixing of the secondary air with the primary air and coal occurs beyond the tip of the burner *E*. The coal stream issuing from the tip *E* in the form of a flare is violently whipped by the stream of secondary air admitted through the vanes *K*, the two streams being in rapid rotation. Impingement of the coal stream on the vanes *E* results in strata consisting of alternate rich and lean mixtures of coal and air. The rich portions of the stream ignite readily and act as kindling to the remainder of the mixture. Initial ignition is secured by means of a kerosene torch, the connection being made at the point *M* on pipe *F*. The degree of the flame is adjusted by advancing or retarding the pipe *F* and the rosette *E*.

Ajax Tension Sleeve Coupling

A TYPE of tension-sleeve coupling designed to facilitate quick changes in direct-connected drive or to permit using one motor to drive different machines at different times, is a recent development of the Ajax Flexible Coupling Co., Westfield, N. Y.

The coupling, which is a modification of the Ajax rubber-bumper coupling, is designed so that the flange *A* attached to the driven shaft is readily removable. This flange is made with an extended split hub having a taper on the outside and a straight threaded portion as shown. A collar *B* is made to fit over the threaded hub and when screwed up to a tension fit, tightens the hub to the shaft, the hub being further held in place by setscrews fitted over two sliding keys.

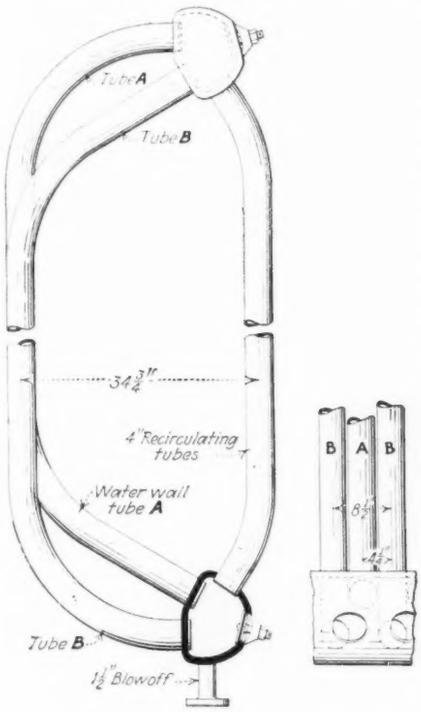
The removable flange *A* and collar *B* are of steel, and the other parts are identical to the standard couplings made by this company and are therefore interchangeable in case of accidental breakage. The coupling flanges are connected by means of special bolts and rubber bushings.



Section of tension-sleeve flexible coupling

Walsh & Weidner Solid Water Walls for Boiler Furnaces

THE illustration shows a water-cooled wall for boiler furnaces recently developed by the Walsh & Weidner Boiler Co., Chattanooga, Tenn. The wall consists of a series of steel tubes of standard boiler sizes arranged along the side walls of the furnace. The space between the tubes is ¼ in., which makes substantially a solid water-cooled heat-absorbing wall. Forged-steel headers are located at the top and bottom of the tubes in each wall and are connected directly into the circulation of the boiler. It is essentially a recirculating wall in which the steam and heated water moves upward through the tubes exposed to the fire, to the top



Design of water wall gives practically solid water-cooled surface

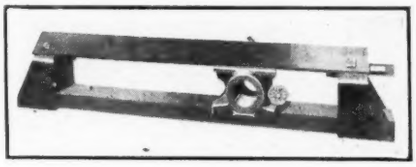
header, where the steam is liberated and passes into the boiler circulation, while the larger amount of water descends through the outside recirculating tubes back to the bottom header. It is claimed that the small amount of water delivered to the boiler proper by the wall tends to minimize the disturbance in the boiler drum and assist in securing drier steam. An important feature of the design is that it presents to the fire the maximum amount of water-cooled heat-absorbing surface per square foot of wall area.

Referring to the illustration, it will be seen that the wall tubes are interchangeable and it is therefore only necessary to carry one standard tube size for spares. Also the header design is such that one handhole serves two tubes. The illustration shows the standard wall, which may be used with brick settings or with a steel casing carried from lugs welded to the tubes, the tubes being backed up with refractory tile and insulating blocks.

Link-Belt Style DS Protected Screw Takeup

THE Link-Belt Co., 300 West Pershing Road, Chicago, announces an improved design "protected-screw" type takeup for heavy work and long-movement, to be known as style "DS."

The frame is of welded structural

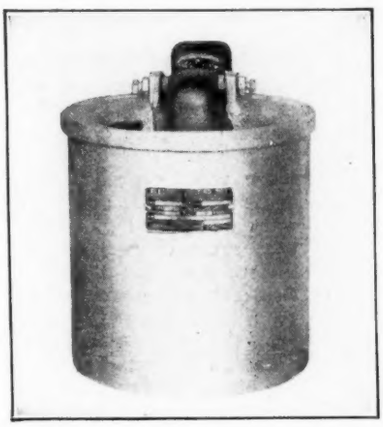


Takeup with Protected Screw

steel with a channel base welded to ends formed of steel plates, bent and welded into box members, in which the adjusting screw is mounted. The steel angle bolted on the top of the ends protects the screw from dirt or the weather, in addition to tying the ends together, strengthening the frame and preventing upward movement of the bearing. The protected screw remains fixed in the position, and the nut for adjusting the movement of the bearing travels on the screw. The screw does not project beyond the ends of the frame. The takeup is fitted with a babbitt-lined cast-iron bearing.

G. E. Melting Pot with Small Capacity

A SMALL electric melting pot having a capacity of from 27 to 40 lb., according to the metal to be melted, is being introduced by the



Small-Capacity Melting Pot

General Electric Co. The pot may be operated on either 110- or 220-volt alternating- or direct-current circuits and is made in two ratings, 750 and 1,000 watts.

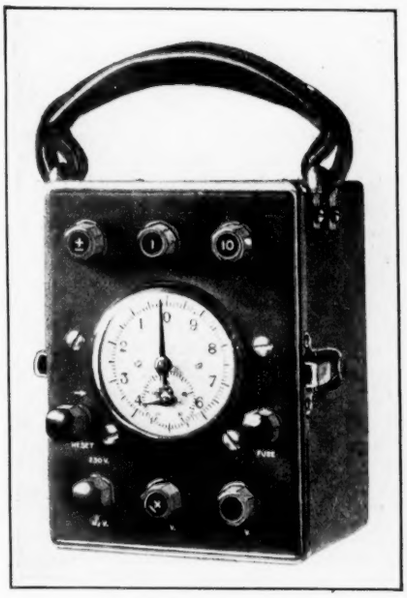
The new pot consists of a sheet-steel cylindrical casing 10 in. deep and 9 in. in diameter, in which is supported a cast-iron crucible 4 in. deep and 6 in. in diameter inside, the space between the crucible and casing being filled with heat insulation.

Heating units are of the cast-in, sheath-wire type, one unit being used in each pot. The leads of the unit are brought over the top of the pot into a connection box fixed to the unit itself.

The new pot is designed for melting lead, babbitt, tin, solder and similar alloys or metals, except spelter or zinc, at temperatures not exceeding 950 deg. F.

Westinghouse Improved Portable Standard Watt-Hour Meter

COMPENSATION for temperature errors at both unity power factor and low power factor and greater accuracy along with a decrease in



Improved portable watt-hour meter

size and weight are the important advantages claimed for the new type OB portable standard watt-hour meter, recently introduced by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. This compensation for temperature errors is inherently permanent for both the electromagnets and the permanent magnets and does not depend on the movement of mechanical parts with the variation in temperature.

The micrometer adjustments have been simplified and the electromagnets are of the one piece OB type. A zero reset is provided by which both pointers can be set on zero. Potential settings are changed by means of a small switch, and three current binding posts are used, so that the meter may be connected for either 1 or 10 ampere capacity.

Bethlehem Backlash Eliminator

A mechanical device that is essential to the functioning of the Bethlehem Torque Amplifier and has many other applications

THE principle of the lashlock (Nieman patents) was discovered by an engineer of the Bethlehem Steel Co. during the construction of a heavy-duty machine (the torque amplifier, described in the Sept. 13 issue) in which it was particularly desirable that there should be no backlash. Development of the original idea has shown that it can be successfully applied to a wide range of machinery, from large mechanisms involving great forces to small and delicate instruments. The lashlock operates to eliminate backlash in gearwheels, feed screws, end-thrusts, bearings—practically wherever play occurs between moving members. It also compensates for wear and automatically relieves strain caused either by tight setting or expansion due to heat.

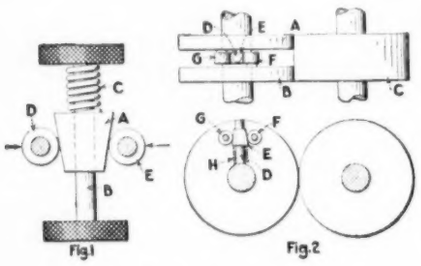


Fig. 1—Wedge type of lashlock.
Fig. 2—Lashlock principle on a split-gear element

Principle of the Lashlock

The basic principle of the lashlock will be seen from Fig. 1. A wedge-shaped member *A* slides on a stem *B* and is urged downward by the light spring *C*. Two rollers *D* and *E* are disposed so that they press against the wedge, as shown. It is obvious that if both rollers press simultaneously against the wedge, it will be forced upward, readily overcoming the pressure of the light spring.

What may not be so obvious at first glance is that, with the slope of the wedge approximately as shown (5 deg. to 10 deg. on each side of the axis), if only one roller is pressed against the wedge the friction between the wedge and stem will be greater than the upward force imparted to the wedge, and the wedge will bind upon the stem. All the force applied to the single roller will thus be imparted to the member that supports the stem, forcing it in the direction in which the roller presses. This binding or locking effect will occur no matter how great the force applied to the single roller, as the proportion between the friction on the stem and the upward force imparted to the wedge remains the same. When both rollers are pressed simultaneously, however, the pressures are balanced and no friction results between wedge and stem; thus all the force applied to the two rollers is brought to bear on moving the wedge upward.

From this examination it is seen that the lashlock depends upon two things —a frictional locking when only one roller is pressed, and a complete release when both rollers are pressed simultaneously.

In Fig. 2 is illustrated, diagrammatically, the lashlock principle on a split-gear element. *A* and *B* are the split members, meshing with the solid gear *C*. Stem *D* is attached rigidly to the shaft which carries the split pair, and on the stem is mounted the wedge member *E*. Rollers *F* and *G* are attached respectively to gears *A* and *B*. A light spring *H* is mounted so as to urge the wedge away from the shaft, thus urging apart the rollers *F* and *G*, and through them imparting rotational urge, though in opposite directions, to the gears *A* and *B*.

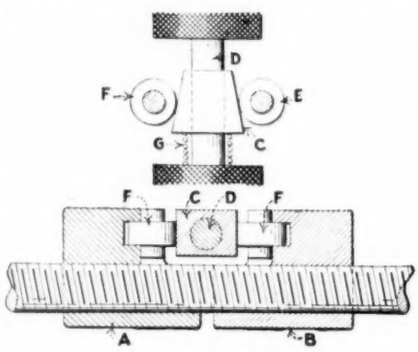


Fig. 3—Wedge type of lashlock applied to lead screw

The wedge will be pushed outward until the teeth on gears *A* and *B* lightly pinch the teeth of gear *C*; this may be termed the "normal" position of the wedge. There are only two circumstances that can cause the wedge to change from this normal position—either both of the rollers *G* and *H* press on it simultaneously or both simultaneously relieve their pressure. Pressure of only one roller will cause binding friction of the wedge on stem; therefore, when the gear *C* begins to drive it will cause one of the split pair to exert pressure on its respective roller and so on one side of the wedge; thus the driving force of *C* will be transmitted to the stem and so to the shaft that carries the split pair. (Gear *C* may, of course, be the driven gear). If *C* reverses the direction of its drive, the other roller will press against the wedge and the shaft driven oppositely. There will be no instant when neither roller is exerting pressure on the wedge and no instant when both rollers are pressing simultaneously.

Typical Application of Lashlock

Application of the lashlock to a screw-feed is illustrated in Fig. 3. Here the same scheme is followed as with the gearing. Two nuts *A* and *B* run on a screw-shaft. The wedge *C* is mounted on a stem *D*, which is supported by the housing of the driven member, while rollers *E* and *F* are attached to nuts *B* and *A* respectively. The wedge, as it is pressed forward by the spring *G*, urges the nuts apart. When the screw-shaft is turned in one direction, one of the nuts forces its roller against one side of the wedge, a frictional binding is created, and through the stem the drive is transmitted to the driven member. Reversal of the screw-shaft produces a drive through the other nut in the opposite direction. There is no lost motion during the reversal, nor can any binding due to unevenness of the threads on either screw-shaft or nuts strain the members.

For thrust bearings—to eliminate end-play in a shaft—the lashlock installation is similar to that in a feed-screw, with the threads and nuts replaced by collars. Two collars are keyed to the shaft a slight distance apart; two other collars are mounted inside the first two, kept from revolving with the shaft but permitted a small endwise movement. Each of these two inside collars carries a roller so mounted as to press against a side of the wedge, the stem of which is attached to the fixed support that bears

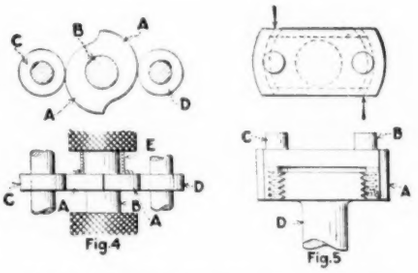


Fig. 4—Double involute cam lashlock.
Fig. 5—Threaded type of lashlock

the thrust. The spring will then urge the inside collars outward against the collars fixed on the shaft; the shaft will not be able, of course, to move endwise in either direction because to do so would mean moving the wedge by pressure on only one roller. Bearing metal is set between the collars and lubrication effected as usual. As the bearings wear, the wedge works inward, taking up this wear and holding the shaft

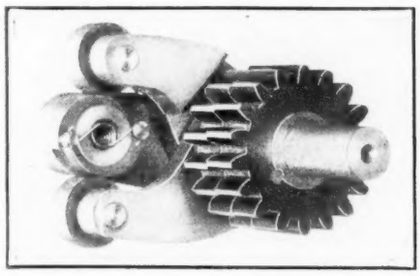


Fig. 6—Pinion with lashlock of double-cam type

always in the same position, endwise, as at the start.

Great flexibility is possible in designing the lashlock to meet situations, for the principle is capable of a variety of forms, some of which appear to depart far from the wedge and roller already illustrated, but all in fact adhering to the essentials of positive locking and automatic release of friction. One such alternative construction is the double cam shown in Fig. 4. Here a double cam replaces the wedge, with faces *AA*; the stem *B* is a pivot on which the cam revolves.

Pressure of either one of the rollers

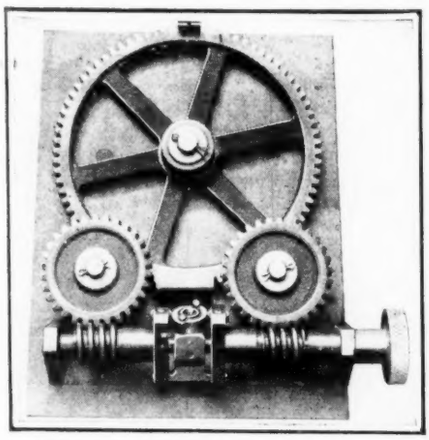


Fig. 7—Model of drive with lashlock in worm shaft

C and *D* will cause a frictional locking between cam and pivot, because the cam faces are cut on an involute so that the pressure of the rollers is always a little to one side of the center. Pressure of both rollers simultaneously relieves the friction between cam and pivot and rotates the cam. The spring *E* urges the cam in a rotary direction opposite to that caused by pressure of the rollers. This form of lashlock is interchangeable with the straight-sided wedge, but fits better into certain constructions.

Another form of lashlock is that shown in Fig. 5. Here the place of the wedge member is taken by a member *A*, of the shape shown. This is provided with two lugs *B* and *C* and with two downwardly projecting arms which form a partial cap embracing the member *D*, corresponding to the stem of Fig. 1. Members *A* and *D* are threaded into each other. No rollers are necessary. Simultaneous pressure on opposite sides of lugs *B* and *C*, as indicated by the arrows, rotates member *A* on member *D*; but pressure on only one lug produces a cocking effect, causes a frictional lock and prevents rotation.

All the pressure exerted on the one lug therefore acts to move the stem in the direction in which the lug delivers the pressure. This form of lashlock is used in the torque amplifier, or in any type of mechanism operating through friction bands, where it is desirable to eliminate backlash when reversal occurs between one drum and its oppositely rotating mate. It does not possess the high degree of accuracy of other forms.

The lashlock can be applied to gears, screws, bearings, thrusts, linkage motions, sliding parts and frictionally driven parts, as shown in Figs. 6 and 7. In some machinery the space required for its installation may prove an obstacle; because of its adaptability, however, and the variety of forms which it can assume, it is usually easy to incorporate it in a design.

The lashlock is applicable to two general classes of machinery: those in which great accuracy is the chief factor, such as certain machine tools, precision instruments and fire-control apparatus; and machines where the elimination of backlash will result in the production of better work and in prolonging the life of the machine by reducing the wear arising from looseness and chatter.

RECENT PUBLICATIONS

STREAM GAGING. By W. A. Liddell, Instructor, Massachusetts Institute of Technology. Published by McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City. 1927. Cloth; 6x9 in., 238 pages; 137 illustrations; 15 tables. Price, $3.

IN ALL hydraulic projects, whether it be waterpower, river control, irrigation or what not, the basic factor is stream flow. Without authentic information on the volumes of water to be expected, the work of designing a hydraulic structure cannot be undertaken intelligently. Many of the failures, both financial and physical, of hydraulic projects have been due to lack of a proper knowledge of the stream flow where they were constructed. Therefore stream gaging is vital in the preparation for any hydraulic undertaking.

In this book the subject has been treated under fourteen titles. Introduction; the flow of water in rivers; distribution of velocities in open channels; stream-gaging stations; gages; channel areas; float and float measurements; current meters; rating the current meter; current-meter characteristics; current-meter measurements; slope and weir measurements; construction and use of station rating curves; effects of ice on stream flow.

In this country the United States Geological Survey has been engaged in stream gaging work for many years, and in this book the author has drawn largely upon the experience gained by that department, as well as the work of the Bureau of Standards and the work by hydraulic engineers in this and other countries. In bringing together information from the various sources of stream-flow experience and the experience of the manufacturers of stream-flow measuring equipment, the author has succeeded in presenting a very comprehensive treatment of the subject.

Such theories of stream flow as bear on the subject of stream gaging have been given, and practical means for applying these theories to the measurement of stream flow have been shown. Characteristics of the various measuring devices have been examined and methods for the analysis of stream-flow data outlined. Where necessary, mathematical treatment has been introduced, but the major part of the work can be easily grasped by those who may be connected with hydraulic work, but who are not hydraulic engineers.

PRESS BULLETIN SERIES NO. 11, ILLINOIS PETROLEUM, will soon be issued from the press by the State Geological Survey at Urbana, Illinois.

THIS issue deals with the recent developments in the oil fields in the vicinity of Jacksonville, Morgan County Additional information obtained from new drillings has enabled the author to describe the structure more accurately than has hitherto been possible. The paper also includes descriptions of the producing horizons, a map, and a cross-section. The operations in the oil fields during the past eight months are summarized in tabular form. As long as copies are available they may be obtained for 25 cents by addressing the Chief, State Geological Survey, Urbana, Illinois.

NEWS *of the* FIELD

Electrotechnical Commission Discusses, But No Action

Leaving Como, Italy—the home of Volta— by boat for Bellagio on Sunday afternoon, Sept. 4, the delegates to the International Electrotechnical Commission assembled in the Hotel Grand-Bretagne at the latter city at 6 p.m., when their sessions were formally opened by President Guido Semenza.

Addresses were made by L. Lombardi, president of the Italian committee; by representatives of two of the Italian ministries of state, and by the Mayor of Bellagio. Twenty-one nations were represented by the 250 delegates assembled. Of these 21 were Americans: C. H. Sharp of the Electrical Testing Laboratories, chairman of the United States National Committee; Dr. C. O. Mailloux, honorary president of the I.E.C.; Theodore Beran, S. E. Doane, H. M. Hobart and F. W. Peek of the General Electric Company; W. M. Bradshaw, Francis Hodgkinson and C. E. Skinner of the Westinghouse Electric & Manufacturing Company; J. H. Dellinger and J. F. Meyer of the Bureau of Standards, Washington; Profs. W. F. Durand, D. C. Jackson, A. E. Kennelly and P. M. Lincoln; L. L. Elden of Boston, R. D. Johnson, L. B. Marks and S. G. Rhodes of New York; W. G. Kelley of Chicago, and E. D. Tanzer of Philadelphia. Canada's delegate was John Murphy of the Department of Railways and Canals, Ottawa.

Of the thirteen committees of the I.E.T., three were headed by delegates from this side of the Atlantic—the committee on nomenclature by Mr. Sharp, that on rating of rivers by Mr. Skinner and that on prime movers by Mr. Murphy.

Prime Mover Papers

At the sessions on Monday the experts' papers on prime movers and switch rating were presented. The committee on electric meters completed its work, recommending further study of problems related to accuracy, insulation tests and sizes. No definite action was taken by the committee on the rating of electrical machinery, which met on Tuesday and Wednesday with a large attendance; nor had definite conclusions been reached up to the end of the first week by the committees on insulating oils, voltages and international vocabulary. Discussions by these committees were still going on, however.

At the dinner given to the delegates by the Italian committee addresses were made by Messrs. Lombardi, Kennelly, Murphy and an Australian representative, John P. Tivey of the Australian General Electric Company.

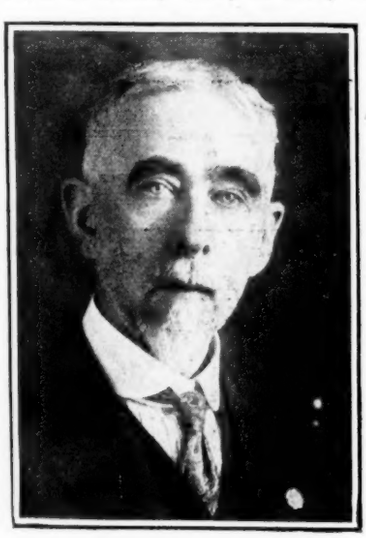
On Tuesday, Sept. 13, the delegates left on a nine-day tour to Milan, Venice, Florence and Rome. The plenary meeting of the commission will be held in Rome on Thursday, Sept. 22.

The next meeting of the commission will be held in the United States in September, 1928.

C. W. Barnaby Ends Active Career as Old Timer M. E.

Charles W. Barnaby, consulting engineer in the field of steam power and for many years designing engineer for the Staten Island Shipbuilding Co., Port Richmond, N. Y., died on Aug. 26.

Born at Salem, Ohio, in 1853, Mr.



Charles W. Barnaby

Barnaby was educated in the public schools of that state. In 1870 he became associated with the Buckeye Engine Co. at Salem, and served his apprenticeship and period as journeyman in that employ. Later, that concern promoted him to the position of chief engineer, but in 1888 he joined the Jenny Electric Co., Indianapolis, where he remained for a year.

In St. Louis in 1890, Mr. Barnaby assisted in the installation of the Municipal Electric Light & Power Co. plant. Shortly after this work he returned to steam power engineering as superintendent of the Phoenix Iron Works, Meadville, Pa. In 1900 Mr. Barnaby became mechanical engineer with the American Engineering Co., Chicago, leaving two years subsequently to fill a similar post with the Atmospheric Products Co., New York.

The C. W. Hunt Co., Staten Island, N. Y., employed Mr. Barnaby as designer and estimator from 1904 to 1908. From that time forward he engaged his efforts in general engineering work, and for the past fifteen years designing for the Staten Island Shipbuilding Co.

Mr. Barnaby became a member of the A.S.M.E. in 1884.

Standardization of Motors, Nuts and Bolts, Gains

Standardization of certain important dimensions governing the interchangeability of electric motors of different makes has made a forward step, according to an announcement by the American Engineering Standards Committee, with the recent acceptance by two prominent organizations, the American Society of Mechanical Engineers and the National Electrical Manufacturers' Association, of joint leadership in the development of such standards.

The National Machine Tool Builders' Association, who found diversity in motor dimensions a problem of particular difficulty in their industry, filed the original request to have the subject taken up by the American Engineering Standards Committee. A conference, to which all parties interested in this subject were invited, was called by the latter body, at which the following scope for the work was recommended:

A series of standard dimensions for the distance from the base to center of shaft (shaft height); a series of standard distances between bolt holes, at right angles to the shaft; a series of standard distances between bolt holes, parallel to shaft, and certain definite combinations of a shaft height with any or both of the distances between bolt holes as mentioned under (b) and (c) maximum diameter and length of the motor.

Upon recommendation by a special committee appointed by the conference, the National Electrical Manufacturers' Association and the American Society of Mechanical Engineers were appointed joint sponsors for the project.

To Control Bolts and Nuts

Tables of standard sizes for square and hexagonal bolt head and nuts and for the corresponding wrench openings were recently approved by the American Engineering Standards Committee as a Tentative American Standard. The sizes of bolt heads and nuts are intended to supersede all existing standards which have grown up from commercial standard bolt heads and nuts. The dimensions listed are in accord with the tendencies of recent years toward smaller sizes for bolt heads and nuts than were given by the "U. S. Standard" thus called because it was established by the Navy Department in 1868. However, such reduction has been made only after giving due consideration to the stresses in bolts and nuts and after exhaustive tests.

Power Applications Reach 483 Reviewed in Year

The Federal Power Commission had before it at the end of the fiscal year, June 30, 483 active applications representing 20,525,773 hp. of primary capacity and 34,782,831 hp. of installed capacity.

California has the greatest number of pending applications. There are 140 of them representing 1,830,440 primary hp. and 4,080,575 of installed capacity. Idaho comes next with 37 pending applications. Alaska has 30; Arizona and Colorado 28 each; Oregon 27; Montana 26; Washington 24 and Utah 18.

The Arizona applications propose by far the greatest amount of development. They cover 9,284,550 of primary horsepower and 13,034,700 hp. of installed capacity. No deductions are made in the foregoing figures for conflicting applications. New York is in second place with 3,923,370 of primary horsepower and 5,133,890 of installed horsepower. California is in third place in the matter of gross horsepower. The figures for that state are: primary, 1,830,440 hp.; installed, 4,080,575 hp. Corresponding figures for the principal other states are: Tennessee, primary 1,226,080 hp. and 2,218,000 installed; Utah, 762,499 primary and 1,127,090 installed horsepower; Washington, 730,094 hp. primary and 1,378,800 hp. installed; Oregon, 390,388 hp. primary and 829,303 hp. installed; Kentucky, 269,300 hp. primary and 689,000 hp. installed; Alabama, 266,160 hp. primary and 951,800 hp. installed; Maine, 250,000 hp. primary and 650,000 hp. installed; Arkansas, 217,000 hp. primary and 650,000 hp. installed; West Virginia, 131,068 hp. primary and 598,000 hp. installed; Colorado, 129,136 primary and 248,305 hp. installed; South Carolina, 127,040 hp. primary and 420,400 hp. installed; Alaska, 121,749 hp. primary and 134,231 hp. installed.

Cooper Pushes Application for Columbia Project

Hugh L. Cooper, of New York, has again applied to the Federal Power Commission for a preliminary permit covering the "Z" Canyon project on Clark Fork of the Columbia River in Pend O'Reille County, Wash., where he proposes to install ultimately twelve 50,000-hp. units under a head of 245 ft.

The initial installation is to be six 50,000-hp. units. Nearly 200,000 hp. of primary power can be developed at the site, Colonel Cooper estimates. A prior application was rejected by the Commission because the applicant was unable at that time to find a market for the power and because of his inability to secure state rights. In the meantime Colonel Cooper has reached an understanding with certain electrochemical manufacturers. In addition to the manufacturing load a part of the power can be utilized for public utility purposes.

The State of Washington would not approve the first application for rights because of the status of the Columbia Basin project. Requirements of that development are now much better understood and Colonel Cooper is hopeful of securing the necessary state authority to proceed.

E. H. Sniffen Now Assisting Westinghouse Sales Manager

Edward H. Sniffen, assistant to vice-president of the Westinghouse Electric & Manufacturing Co., has transferred his office from East Pittsburgh, Pa., to New York City, and is now located at

Edward H. Sniffen

the Westinghouse Building, 150 Broadway. His duties are of an executive nature, assisting E. D. Kilburn, vice-president and general sales manager.

Mr. Sniffen, previous to assuming his present position was vice-president of the Westinghouse Machine Co. He later became manager of the power department when that was absorbed by the Electric company. He is well-known in the power field as one of the men early instrumental for the general use of the steam turbine in the United States.

Mr. Sniffen was Mr. Westinghouse's commercial aid. It was his duty to locate opportunities to install turbines and to persuade prospective purchasers that the advantages of these machines outweighed the risks involved in using new and untried apparatus. He personally directed the sale of the famous 1500-kw. unit installed at Hartford in 1900, at that time the largest built, and also of the several latter units which have now become historic.

Germany Gets World Power Conference in 1930

The next World Power Conference will be held in Germany in 1930. A definite decision to that effect was reached last week by the International Executive Committee meeting in Cernobbia, Italy. It also is decided to hold a sectional meeting in Tokio in 1929.

Tentative arrangements had been made to hold the next conference in Italy, but the Italian committee explained that the conference could be held more profitably in Italy at a later date when its hydro-electric program will have developed somewhat further.

The foregoing information was contained in a cablegram received by the chairman of the American committee from H. J. Pierce, the vice-chairman, who represented the American group at the executive committee meeting. Mr. Merrill was unable to be present at the meeting.

Adjustable Bladed Waterwheels for Chippewa Falls Plant

Featuring the development of hydro-electric power for the Northern States Power Co. at Chippewa Falls on the Chippewa River will be the use of waterwheels with adjustable blades, which will enable the plant to operate at maximum efficiencies as the load or demand varies.

Work has been started under the direction of Byllesby Engineering & Management Corp., according to an announcement by H. W. Fuller, vice-president in charge of engineering and construction. Mr. Fuller's statement confirms preliminary plans announced late in 1926. Present work consists of preparation of the site, so that construction work may now proceed rapidly.

The Chippewa Falls plant will have a capacity of 30,000 hp., in six units of 5,000 hp. each. The dam and power house will be in Chippewa Falls, about three miles below the hydro-electric development at Wissota, which has a capacity of 42,000 hp. It will utilize water storage created by the Wissota dam, operating synchronously, or "in step," with Wissota, and will be tied in with the extensive transmission system of Northern States Power Co. in Wisconsin and Minnesota. The Chippewa Falls development will operate under a head of 30 ft.

Welded Motor Frame Patents To Lincoln Electric

Recent patents issued to the Lincoln Electric Co. include welded steel motor frames in which welded steel construction has replaced castings. The patents issued were 1,629,877 and 1,629,876, assigned to the Lincoln Electric Company, Cleveland, through James F. Lincoln.

The construction is an assembly of hot-rolled steel parts welded into the equivalent of a casting. The claims allowed for the method of construction cover its use only to dynamo electric machines. According to the statements of the Lincoln Electric Co. engineers, it is claimed that the welded steel method of construction gives a practically unbreakable frame, lighter weight and better ventilation.

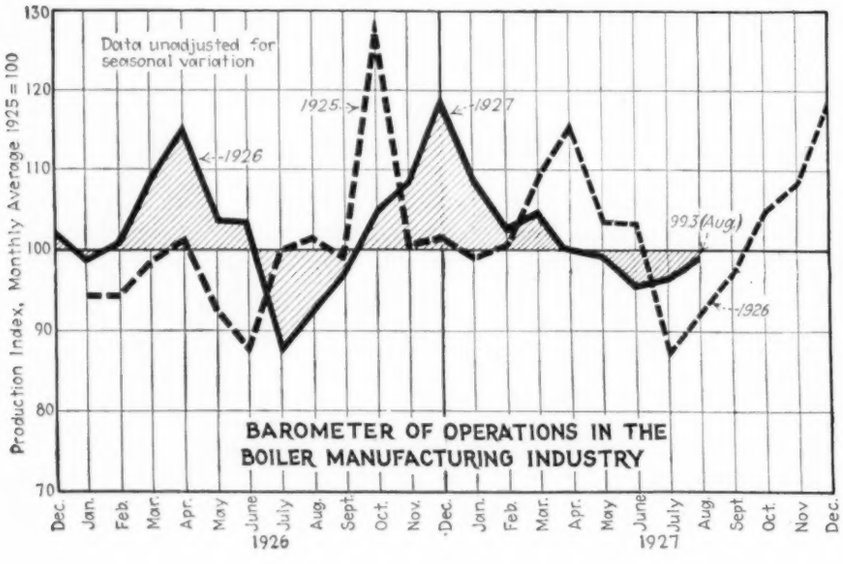
August Boiler Production Below July, But Tops Year Ago 4 Per cent

During August the boiler manufacturing industry of the company failed to continue the upward trend which was initiated during June. According to reports received by *Power* on the monthly consumption of electrical energy by boiler manufacturing companies, the actual boiler production during August was 2.2 per cent over that of July, but after corrections are made for the fact that August had two more working days than July, it is found that the rate of boiler production during August was about 5.5 per cent under July. A comparison with last year indicates that during August the activities of these plants taken as a whole were 4 per cent over those witnessed during August of last year. The operations of the industry appear to be holding up much better than at this time last year.

The operations of the boiler manufacturing plants appear to be following very closely the operations of general industry. Industrial production in general for the country as a whole during August was about 0.3 per cent under August 1926. This is the first month since February that general productive operations have fallen below the 1926 level. The average daily production of industry in general was approximately at the same rate as that reported for July of the current year.

The basic reports from boiler manufacturers indicate that production conditions are very irregular. A similar situation appears to exist in industry in general. In industries in which the general trend in rate of production during August was upward, many manufacturing plants reported a material drop in operations, while some plants reported near record activities when the general operating trend of the industry is downward. Manufacturing industry as a whole appears to be marking time awaiting the upward impulse which must come through the channels of distribution.

That this impulse is under way and will unquestionably be reflected in materially increased industrial operations during the fall months is indicated from the facts that the average daily bank debits during August were about 3 per cent over those of last year.



Obituary

E. G. McALEENAN, of the McAleenan Brothers Co. and the McAleenan Corp., manufacturers of steam boilers, died at his home in Pittsburgh, Sept. 10 at the age of sixty-one. He was born in Peoria, Ill., and came to Pittsburgh with a brother, George R. McAleenan, in 1899. With his brother he founded the steam boiler-making company bearing his name in 1915 and founded the McAleenan Corp. in 1921.

Mr. McAleenan was a member of the Pittsburgh Athletic Association and the Keystone Athletic club.

Personal Mention

WILLIAM BLANCHARD, JR., has been appointed district manager in charge of the Chicago office of McClellan & Junkersfeld, Inc.

WILLIAM C. GRIESSER is now associated with the Vilter Manufacturing Co., Milwaukee, builders of ice and refrigerating equipment, having joined the engineering department of the company.

A. M. MACCUTCHEN, engineering vice-president of the Reliance Electric & Engineering Co., Cleveland, is now serving as chairman of the A.I.E.E. committee on general power application.

NORMAN GREIG, mechanical engineer, until recently chief engineer for the Central Machete Co., Guayama, Porto Rico, is now serving in like capacity for the Central Aguirre Sugar Co., 129 Front St., New York City.

W. S. GORSUCH, electrical engineer, with the Interborough Rapid Transit Co., New York City, is in charge of the A.I.E.E. committee on power generation.

W. A. LEAN has become associated with the Wilcolator company, Newark, N. J., manufacturers of thermostatic control equipment, in the capacity of sales engineer. Mr. Lean was formerly connected with the Cutler-Hammer Manufacturing Co., Milwaukee, Wis., having been connected with the New York office for the last ten years.

A. W. ATWATER, for the last two years a partner in the firm of Martin & Warlick Co., engineering contractors, of Chattanooga, Tenn., and for some time previous to that engaged in power-high plant and architectural engineering in Cleveland and Columbus, Ohio, has joined the organization of Stone & Webster, Inc., Boston, as engineer in the mechanical department.

E. N. D'OYLY has been appointed as electrical engineer of the western district of the electrical division of the engineering department of the Byllesby Engineering & Management Corp., according to announcement by H. W. Fuller, vice-president in charge of engineering and construction. Mr. D'Oyly, who was formerly with the Western States Gas & Electric Co. at Stockton, Calif., succeeds A. H. Tracy, resigned.

W. POOLE DRYER, for several years with the General Electric Co., most recently in Philadelphia where he has been assisting on plans for the new factory, and previously at Schenectady, where he was designing engineer on large steam turbines, has become a member of the mechanical division of Stone & Webster, Inc., at the Boston office. Mr. Dryer formerly carried on a private consulting practice on small power plant work.

Business Notes

THE FOSTER-WHEELER CORP., 165 Broadway, New York City, has acquired license to manufacture the new Foster sectional air heater under the Haber patents.

THE YOUNG RADIATOR CO., manufacturers of cooling systems and heating units, Racine, Wis., has announced the appointment of J. J. Hilt as sales manager, Mr. Hilt having assumed his duties Aug. 20.

THE COFFIN VALVE CO., Boston, announces the appointment of the Chapman Valve Manufacturing Co. as exclusive sales agents in the United States, Canada, Mexico and Cuba for the sale of Coffin sluice gates, shear gates and tide flap gates.

THE FOOTE BROS. GEAR & MACHINE CO. recently appointed J. C. Rowett as factory district representative for the State of Minnesota and territory in northwestern Wisconsin. Mr. Rowett will make his headquarters at 406 Sixth Ave., South, Minneapolis, Minn.

THE CLIMAX ENGINEERING CO., Clinton, Iowa, announces the appointment of John Reiner & Co., Inc., 309 Church St., New York City, N. Y., as Climax service representatives for the States of Connecticut, New York and New Jersey. John Reiner & Co., Inc., maintain a complete assortment of repair parts for all models of Climax engines and have available a corps of experienced service engineers.

THE HAYS CORP., Michigan City, Ind., manufacturer of combustion instruments, announces the addition of several representatives to the sales organization. S. Thomas Engineering Co., 6625 Delmar Blvd., St. Louis, Mo., for Eastern Missouri and Southern Illinois. Jos. H. Spurgeon, 3-224 General Motors Bldg., Detroit, for Eastern Michigan and Northwestern Ohio. H. R. N. Johnson, 621 New York Life Bldg., Minneapolis, for Minnesota and the Dakotas, and Louis Towner Construction Co., 551 Valley Ave., N. W., Grand Rapids, Mich., for Grand Rapids and contiguous territory.

Trade Catalogs

FILES—The Wave Cut File & Tool Corp., 44 Beaver St., New York City, in a small special bulletin treats of the wave cut file claimed to give faster, cleaner, and smoother performance than "ordinary files."

CRANES AND TROLLEYS—H. D. Conkey & Co., Mendota, Ill., has issued a new catalog on cranes and trolleys. The catalog is in fact an engineer's data book, giving complete specifications, clearances, list prices and other valuable crane and trolley information useful to engineers and users of crane and trolley equipment.

INSULATION SPECIALISTS—The Ehret Magnesia Manufacturing Co., Valley Forge, Pa., has put out a well illustrated catalog, No. A-26, describing in some detail the insulation products for power, heat, water and refrigeration, manufactured by the company. Ehret's 85 per cent magnesia section pipe coverings, segmental insulation, flat and curved blocks, high temperature insulation and other specialties are fully described and pictured by sectional cuts and installation views. The practical value of this catalog is enhanced by the clarity and completeness of the specification and data section.

AUTOMATIC ELECTRIC MELTING POTS—A new leaflet has been released describing the automatic electric melting pots of the Westinghouse Electric and Manufacturing Company. This publication, L-1868-B, covers the applications for which these pots are suitable and gives interesting operating data as well, listing the advantages secured by using this apparatus. The pots described have a maximum operating temperature of 950° F. and are largely used for melting soft metals, such as babbitts, and for low temperature drawing baths in the heat treatment of steel tools and parts. Copies of this leaflet may be had at any of the district offices or from the Advertising Department at East Pittsburgh, Pa.

HEATING APPARATUS—The Westinghouse Electric & Manufacturing Co. has issued a complete catalog of industrial electric heating apparatus, designated as Catalog 25. Twenty-seven different types of equipment are listed, including box furnaces, lead and salt baths and pots, pit rotary hearth and pusher furnaces, special furnaces and ovens, drawing baths and ovens, laboratory furnaces, strip heaters of all classes, automatic melting pots, control equipment and accessories. For the standard furnaces and ovens production curves are given which enable one to estimate accurately in advance the kilowatt hours required to turn out a certain amount of steel when heated to a definite temperature. The publication is profusely illustrated to show the various apparatus and its construction.

Coming Conventions

American Boiler Manufacturers Association, winter meeting, Hotel Cleveland, Cleveland, Feb. 7; A. C. Baker, sec., 801 Rockefeller Bldg.

American Society of Heating & Ventilating Engineers, hold general meeting in New York City, during 4th week in January; A. V. Hutchinson, sec., 29 W. 39th St., New York.

American Society of Refrigerating Engineers, annual convention in New York, Dec. 5-7; W. H. Ross, sec., 37 W. 39th St., New York City.

American Water Works Association. California Section, at San Jose, Oct. 5-8; Paul E. Magerstadt, sec., East Bay Water Co., Oakland; North Carolina Section, at Durham, Nov. 7-9; H. G. Baity, sec., Univ. North Carolina, Chapel Hill; Southwest Waterworks Association will meet at Hot Springs, Ark., Oct. 10; Lewis A. Quigley, sec., superintendent of City Waterworks, Fort Worth, Tex. Iowa Section, at Council Bluffs, Hotel Chieftain, Sept. 28-30; Jack J. Hinman, Jr., secretary, P.O. Box 313, Iowa City.

American Socity of Mechanical Engineers, convention during week of New York Power Show, New York City, Dec. 5-10; Calvin Rice, sec., 29 West 39th St., New York City.

American Welding Society, fall meeting at Book Cadillac Hotel, Detroit, Sept. 19-23.

Association of Edison Illuminating Co's, convention at Colorado Springs, Col.; Sept. 26-30.

Empire State Gas and Electric Association, meeting at Lakeside Club House, Lake Placid, N. Y.; Oct. 6-7; C. H. B. Chapin, sec., Grand Central Terminal, New York City.

National Association of Practical Refrigerating Engineers. Eighteenth annual convention and educational exhibition in Civic Convention Hall and headquarters Hotel Whitcomb, San Francisco, Calif., Nov. 29 to Dec. 2. H. Fox, 5707 W. Lake St., Chicago, Ill.

National District Heating Association, annual meeting in May; D. L. Gaskill, sec. 112 West 4th St., Greenville, Ohio.

National Fuels Meeting, under the auspices of the Fuels Division of the American Society of Mechanical Engineers, will be held at the Hotel Statler, St. Louis, Mo., Oct. 10-13. Address inquiries to William G. Christy, Citizens' Smoke Abatement League, Chamber of Commerce Bldg., St. Louis, Mo.

New York Power Show (National Exposition of Power and Mechanical Engineering) will be held at the Grand Central Palace, New York City, Dec. 5-10. Address inquiries to the International Exposition Co., Grand Central Palace.

Stoker Manufacturers Association, fall meeting at Buckwood Inn, Shawnee-on-Delaware, Pa., Sept. 26-28.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Sept. 7 1927
Pool 1	New York	$2.50@$2.75
Smokeless	Boston	1.61
Clearfield	Boston	1.60@ 1.90
Somerset	Boston	1.70@ 2.00
Kanawha	Columbus	1.75@ 2.00
Hocking	Columbus	2.00@ 2.25
Pittsburgh	Pittsburgh	1.90@ 2.00
Pittsburgh gas slack	Pittsburgh	1.35@ 1.60
Franklin, Ill	Chicago	
Central, Ill	Chicago	
Ind. 4th Vein	Chicago	
West Ky	Louisville	2.00@ 2.50
S. E. Ky	Louisville	1.40@ 1.75
Big Seam	Birmingham	1.60@ 2.00
Anthracite (Gross Tons)		
Buckwheat No. 1	New York	3.00@ 3.75
Buckwheat No. 1	Philadelphia	3.00@ 3.75
Birdseye	New York	1.50@ 1.75

FUEL OIL

New York—Sept. 15, light oil, tank-car lots; 28@34 deg. Baumé, 5c. per gal.; 36@40 deg., 5¼c. per gal. f.o.b. Bayonne, N. J.

St. Louis—Sept. 7, tank-car lots, f.o.b. St. Louis; 24@26 deg., $1.625 per bbl.; 26@28 deg., $1.675 per bbl.; 28@30 deg., $1.725 per bbl.; 30@32 deg., $1.775 per bbl.; 32@36 deg., gas oil 4.3c. per gal.; 38@40 deg., 5c. per gal.

Pittsburgh—Sept. 7, f.o.b. local refinery; 30@34 deg., fuel oil, 4¾c. per gal.; 36@40 deg., fuel oil, 5c. per gal.

Philadelphia—Sept. 8, 26@30 deg., $2@$2.06 per bbl.; 13@19 deg., $1.68@$1.74 per bbl.; 22 plus, $1.79@$1.85; 27@30, $2.10@$2.16.

Cincinnati—Sept. 5, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5¼c. per gal.; 26@30 deg., 5½c. per gal.; 30@32 deg., 5¾c. per gal.

Chicago—Sept. 10, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl.; 24@26 deg., 95c. per bbl.; 26@30 deg., 97½@$1.00; 30@32 deg., $1.05.

Boston—Sept. 12, tank-car lots, f.o.b. 12@14 deg. Baumé, 4¼c. per gal; 28@32 deg., 5.8c. per gal.

Dallas—Sept. 10, f.o.b. local refiners, 26@30 deg., $1.45 per bbl.

NEW PLANT CONSTRUCTION

Ark., Little Rock—Arkmo Lumber Co., Rector Bldg., will build a planing mill including boiler house, etc. at West Broadway and Fourth St. by day labor. Estimated cost $100,000.

Calif., Los Angeles—Broadway Department Store, awarded contract for the construction of an 11 story department store at Broadway and Fourth St. to P. J. Walker Co., W. M. Garland Bldg. Estimated cost $800,000. Steam heating system, elevators, etc., will be installed.

Calif., Los Angeles—Lilly-Fletcher Syndicate, is having preliminary plans prepared for a 13 story apartment including steam heating and refrigeration systems, elevators, etc. at Kenmore Ave. and Wilshire Blvd. Estimated cost $1,250,000. Walker & Eisen, 1117 Western Pacific Bldg., are architects.

Calif., Los Angeles—Pacific Southwest Trust & Savings Bank, awarded contract for a 6 story bank and office building at Hollywood Blvd. and Highland Ave. to Meyer & Holler, Wright & Callendar Bldg. Estimated cost $500,000. Steam heating system, elevators, etc. will be installed.

Calif., San Francisco—Decimo Club, T. M. Cole, chn., 358 Flood Bldg., is having plans prepared for a 14 story club building at Eddy and Larkin Sts. Estimated cost $2,000,000. W. F. Gunnison, Shreve Bldg., is architect.

Calif., San Francisco—Islam Temple of Mystic Shrine, Shrine Temple, plans the construction of a 35 story masonic Temple and office building. Estimated cost $5,000,000. Architect and engineer not selected.

Ill., Chicago—Buildings Development Co., 160 North La Salle St., awarded contract for the construction of a 23 story office building to Lundoff-Bicknell Co., 180 North Michigan Ave.

Ill., Chicago—Madison-Clark Building Corp., c/o D. H. Burnham & Co. Inc., 160 North La Salle St., awarded contract for a 23 story office and stores building at Madison and Clark Sts. to Fitzgerald Construction Co., 105 West Monroe St.

Ill., Chicago—E. M. Willoughby, 77 West Washington St., is having sketches made for the construction of a 36 story office and stores building at Madison St. and South Michigan Ave. S. N. Crowen & Co., 22 West Monroe St., are architects.

Mass., Boston—Woodstock Trust, c/o H. F. Kellogg, 378 Stuart St., is having preliminary plans prepared for the construction of a 14 story office building at 89 Broad St.

Mass., Newton (Boston P.O.)—Newton Hospital, E. E. Kelsey, Pres., Woodlawn St., awarded contract for a hospital, nurses' home and power house at Washington and Beacon Sts. to Holt-Fairchild Co., 7 Water St., Boston. Estimated cost $1,500,000.

Mass., North Attleboro—Elm Amusement Co., J. Levenson, 27 School St., Boston, is receiving bids for remodeling heating plant on North Washington St. here. Estimated cost $30,000. Funk & Wilcox, 25 Pemberton Sq., Boston, are architects and engineers.

Mich., Detroit—Dept. of Water Supply, G. H. Fenkell, Gen. Mgr., 176 East Jefferson Ave. is having plans prepared for waterworks improvements including new auxiliary pumping station at Waterworks park. Estimated cost $500,000.

Mo., Columbus—The Tiger, Inc., c/o W. E. Smith, awarded contract for the construction of a 9 story hotel and theatre at South Eight between Broadway and Cherry St. to Simon Construction Co. Estimated cost $500,000. Steam heating system, etc. will be installed.

Mo., Macon—City awarded contract for waterworks improvements including pumping station, two 700 g.p.m. centrifugal pumps, etc. to B. F. Brooks Construction Co., Dallas, Tex. Estimated cost $108,439.

Mo., St. Louis—Owner c/o C. E. Etz, 110 North 7th St., is having preliminary plans prepared for an apartment including vapor heating and electric refrigeration systems, etc. at South Kingshighway. Estimated cost $500,000.

N. J., Bayonne—F. & L. Mongiello, 74 West 23rd St., will build an ice plant at 78-84 West 23rd St. Estimated cost $40,000. Private plans. Work will be done by separate contracts.

N. J., New Brunswick—Public Service Corp., 80 Park Pl., Newark, plans addition to power house on Albany St. here. Estimated cost $40,000. Public Service Production Co., 80 Park Pl., Newark, is architect.

N. J., Red Bank—Red Bank Hotel Co., Broad and Mechanic Sts., will soon receive bids for a 9 story hotel including steam heating and ventilation systems, boilers, pumps, elevators, etc. at Riverside Ave. Estimated cost $650,000. N. Harris, 20 Branford Pl., Newark, is architect.

N. J., South Orange—Sixty Two South Munn Ave. Corp., Chamber of Commerce Bldg., Newark, will build a 10 story apartment including steam heating system, etc. here. Estimated cost $1,500,000. H. F. Clark, 38 Clinton St., Newark, is architect. Work will be done by separate contracts.

N. Y., Long Island City—Realty Construction Corp., 307 7th Ave., New York, had plans prepared for a 12 story office building at Hunters and 41st Aves. here. Estimated cost $1,000,000. Shampan & Shampan, 188 Montague St., Brooklyn, are architects.

N. Y., Rochester—Graven & Mayger, 180 North Michigan Ave., Archts., Chicago, Ill., will receive bids until Sept. 26 for superstructure of a theatre and commercial building here, for Banorge Corp., New York, N. Y. Estimated cost $1,500,000.

Okla., Oklahoma City—Builders Exchange Co., awarded contract for the construction of a 10 story office building at Grand and Robinson Sts., to Reinhart & Donovan, Tradesmens Bldg. Estimated cost $775,000. Steam heating system, elevators, etc. will be installed.

Okla., Oklahoma City—Syndicate, c/o C. H. Morean, First National Bank Bldg., is having preliminary plans prepared for the construction of a 24 story hotel on Grand St. Estimated cost $2,000,000. Architect not selected.

Okla., Oklahoma City—L. W. Wentz, Ponca City, is having preliminary plans prepared for the construction of a 10 story hotel at Fourth St. and Broadway. Estimated cost $1,000,000. Architect not selected.

Okla., Tulsa—C. C. Cole, Cole Bldg., is having preliminary plans prepared for the construction of a 20 story office building. Estimated cost $1,500,000. Architect not selected.

Okla., Tulsa—R. T. Daniels, Daniels Bldg., is having preliminary plans prepared for a 27 story office building on Cincinnati St. Estimated cost $1,500,000. Architect not selected.

Okla., Tulsa—Exchange National Bank, plans the construction of a 27 story office building at Boston St. Estimated cost $2,500,000. Weary & Alford, 1923 Calumet Ave., Chicago, Ill., are architects.

Okla., Weleetka—Oklahoma Power Co., Okmulgee, is having preliminary plans prepared for a new 20,000 kw. steam turbine unit addition to power plant here. Estimated cost $200,000. Byllesby Engineering Co., 231 South La Salle St., Chicago, Ill., is engineer.

Pa., Allentown—Arcadia Mills, 749 Pittston Ave., awarded contract for the construction of a 70 x 70 ft. power house, etc. to Ochs Construction Co., 440 Wire St.

Pa., Mayview—Dept. of Charities, Pittsburgh, is having plans prepared for the construction of a city home and hospital here. Estimated cost $2,500,000. E. F. Wood & Co., Hardy Hayes Bldg., Pittsburgh, are architects.

Pa., Philadelphia—Charles J. McIlvaine, c/o McIlvaine & Roberts, Otis Bldg., Archts. awarded contract for the construction of a 20 story apartment building at 2031 Locust St. to Roberts & Roller, 1700 Walnut St. Estimated cost $1,000,000.

Pa., Pittsburgh—P. M. Julian, 917 15th St. N.W., Washington, D. C., is receiving bids for a 10 story hotel and stores building including electric refrigeration system, elevators, etc. here. Estimated cost $2,000,000. Owners' name withheld.

Tex., Fort Worth—G. T. Vickers, 913 First National Bank Bldg., Fort Worth and J. H. Jones, Goggan Bldg., Houston, are having plans prepared for a 19 story hotel at Rio Grande and Summit Sts. Estimated cost $1,000,000. W. C. Hendrick Inc., 1005 First National Bank Bldg., Fort Worth, is architect.

Tex., Mission—Hidalgo County Water Control & Improvement Dist. No. 6, voted $1,600,000 bonds for irrigation project, 23,000 acres of land involved, including pumping units, probably electrically driven pumps, etc. P. Levine, Edinburg, is county engineer.

Tex., Port Arthur—City plans an election in October to vote $75,000 for waterworks improvements including pumping equipment, mains, etc. Estimated cost $75,000. W. O. Bower, is city engineer.

Tex., San Antonio—San Antonio Turn Verein, c/o A. Von Jess, Houston and Nacogdoches, Sts., is having plans prepared for the construction of a 26 story hotel and club building at Travis, Houston and Nacogdoches Sts. Estimated cost $1,500,000. L. Harrington & Co., Builders Exchange Bldg., architects and engineers.

Wash., Seattle—Bd. of Public Works, will soon award contract for the construction of a dam on the Skagit River at Diablo Canyon in connection with hydroelectric project.

Ont., Toronto—Superior Reality Co., Ltd., c/o Kaplan & Sprachman, 305 Dundas St. W., Archts., plans the construction of five 4 story apartment buildings including steam heating and refrigeration systems, etc. Estimated cost $500,000.

Equipment Wanted

Boiler and Turbo Generator—Arkansas Utilities Co., R. M. Foster, Mgr., Helena, Ark., is in the market for a 600 hp. boiler also a new turbo generator. Estimated cost $150,000.

Boiler—Commonwealth of Pennsylvania, B. E. Taylor, Secy., Capitol, Harrisburg, Pa., will receive bids until Sept. 21 for furnishing and installing a new high pressure water tube boiler with superheater, chain grate stoker, etc. for Capitol power plant.

Boilers and Electric Hoist—Bd. of County Comrs., Cleveland, O., will receive bids until Sept. 21 for two high pressure boilers with automatic stokers also a 3 ton electric hoist for Miles Ave. storeyards.

Electrical Switching Equipment—Dept. of City Transit, H. E. Ehlers, Dir., 1211 Chestnut St., Philadelphia, Pa., will receive bids until Sept. 22 for the installation of electrical switching equipment in sub-stations 4, 5 and 6 for Broad St. subway.

Motors—P. O. Box 254 Station A., Boston, Mass., is in the market for 1 and 2 hp. electric motors, 110 v. d.c. compound and series wound.

Pump—H. Meloche, 24 A. St. Joseph St., Dorral, Que., is in the market for a 1000 g.p.m. steam, oil or gasoline driven pump.

Pump, Motor, Etc.—E. F. Fowler, Clk. Harriman, N. Y., will receive bids until Sept. 29 for a deep well pump and motor, etc. for proposed waterworks system.

Pump and Motor—City of Hobart, Okla., is in the market for a 600 g.p.m. fire pump and motor.

Pump and Pumping Unit—U. S. Veterans Bureau, Arlington Bldg., Washington, D. C., will receive bids until Oct. 11 for furnishing and installing a deep well pump and additional pumping unit in U. S. Veterans Hospital, Bedford, Mass.

Pumps, Etc.—City of Brampton, Ont., will be in the market for centrifugal pumps, etc. for proposed waterworks improvements. Estimated cost $50,000.

Pumps, Etc.—P. Schumacher, Acting Clk., Trenton, O., will receive bids until Sept. 23 for two 35,000 g.p.m. motor driven pumps, etc. for proposed waterworks improvements.

Pumping Unit—City of Devine, Tex., will receive bids after Sept. 17 for a pumping unit, etc. for proposed waterworks improvements. Estimated cost $45,000.

Pumping Unit—Dept. of Water Supply, D. C. Grobbel, Acting Secy., Detroit, Mich., will receive bids until Oct. 5 for a 10,000, g.p.m. electric motor driven centrifugal pumping unit with auxiliary equipment for proposed waterworks improvements.